RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol. 66 APRIL, 1956 No. 4

CONTENTS

RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

GENERAL INFORMATION

RADIOLOGY is entered as second class matter at Syracuse, New York, and Easton, Penna., under the Act of August 24, 1912, and accepted November 24, 1934. RADIOLOGY is published by the Radiological Society of North America as its official Journal. Subscription rate $10.00 per annum. Canadian postage, $1.00 additional. Foreign postage, $2.00 additional. Single copies $2.00 each. All correspondence relative to business matters connected with the Radiological Society of North America and RADIOLOGY, or remittance for non-member subscriptions, should be made payable to the Radiological Society of North America and should be addressed to the BUSINESS MANAGER, DONALD S. CHILDS, M.D., 713 E. GENESEE STREET, SYRACUSE 2, NEW YORK. In requesting change of address, both the old and the new address should be given.

Dues to the Radiological Society of North America include subscription to RADIOLOGY and should be paid to DONALD S. CHILDS, M.D., SECRETARY-TREASURER, 713 E. GENESEE STREET, SYRACUSE 2, N. Y.

The rate for "want" advertisements for insertion in the Classified Section is 8 cents per word, minimum charge $2.00. Remittance should accompany order. Rates for display advertisements will be furnished upon request.

Inquiries regarding the program for the Annual Meeting of the Society for the current year should be sent to the President.

RADIOLOGY is published under the supervision of the Publication Committee of the Radiological Society of North America, which reserves the right to reject any material submitted for publication, including advertisements. No responsibility is accepted by the Committee or the Editor for the opinions expressed by the contributors, but the right is reserved to introduce such changes as may be necessary to make the contributions conform to the editorial standards of RADIOLOGY. Correspondence relating to publication of papers should be addressed to the Editor, HOWARD P. DOUB, M.D., HENRY FORD HOSPITAL, DETROIT 2, MICHIGAN.

Original articles will be accepted only with the understanding that they are contributed solely to RADIOLOGY. Articles in foreign languages will be translated if they are acceptable. Manuscripts should be typewritten double-spaced, with wide margins, on good paper, and the original, not a carbon copy, should be submitted. The author's full address should appear on the manuscript. It is advisable that a copy be retained for reference as manuscripts will not be returned.

Illustrations and tables should be kept within reasonable bounds, as the number which can be published without cost to the author is strictly limited. For excess figures and for illustrations in color, estimates will be furnished by the Editor. Photographic prints should be clear and distinct and on glossy paper. Drawings and charts should be in India ink on white or on blue-lined coordinate paper. Blueprints will not reproduce satisfactorily. All photographs and drawings should be numbered, the top should be indicated, and each should be accompanied by a legend with a corresponding number. Authors are requested to indicate on prints made from photomicrographs the different types of cells to which attention is directed, by drawing lines in India ink and writing in the margin. The lines will be reproduced, and the words will be set in type. Attention should be called to points which should be brought out in completed illustrations, by tracings and suitable texts. These instructions should be concise and clear.

As a convenience to contributors to RADIOLOGY who are unable to supply prints for their manuscripts, the Editor can arrange for intermediate prints from roentgenograms.

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

Vol. 66 APRIL 1956 No. 4

Amyloid Disease

Its Roentgen Manifestations[1]

C. C. WANG, M.D., and LAURENCE L. ROBBINS, M.D.

THE PATHOGENESIS of amyloid disease is poorly understood; yet its clinical and pathological manifestations were first observed by Rokitansky (9) and were subsequently described in detail by Virchow (13), in 1858. Since its recognition as a disease entity, sporadic case reports have appeared in the world literature, but little has been written from the radiologist's point of view. We have sought therefore to discover and summarize the roentgen aspects of the condition.

Amyloid is a starch-like material of waxy appearance, which stains readily with iodine. Its exact chemical nature is not well understood, but it is regarded as a complex substance containing protein and polysaccharides.

There are two types of amyloid disease, primary and secondary. Primary amyloidosis is relatively uncommon, approximately 70 cases having been reported. The amyloid is usually deposited in the lungs, heart, and blood vessels throughout the body; it is found less frequently in the spleen and gastrointestinal tract. Primary amyloidosis is not associated with chronic sepsis nor with any other known etiologic factor. The amyloid does not always absorb the usual stains, such as Congo red, iodine, or methyl violet. A solitary tumor-like deposit may, on rare occasions, be found in a particular organ; the nasal septum, thyroid, tongue, and larynx are frequent sites.

Secondary amyloidosis, the more common form of the disease, is usually associated with long standing infections and tissue-destroying processes. It is often found with rheumatoid arthritis, bronchiectasis, tuberculosis, and malignant tumors. In contrast to the primary form, the secondary amyloid absorbs stains well. The deposits occur almost always in the liver, spleen, kidneys, and adrenal glands.

A particular type of amyloid disease associated with multiple myeloma usually follows the distribution pattern and staining reaction commonly seen in primary amyloidosis.

From a clinical standpoint, the signs and symptoms of amyloidosis vary, depending upon the system primarily involved. When there is considerable infiltration of the kidneys, the findings may be similar to those of the nephrotic syndrome. If the liver or spleen is significantly involved, there may be no particular symptoms but the organs may be palpable. Involvement of the stomach may cause hematemesis, epigastric distress, and pyloric obstruction, or the patient may be asymptomatic. When the small bowel is infiltrated, chronic diarrhea is a frequent manifestation. Amyloid deposition in the heart may produce no clinical evidence of its presence, except for

[1] From the Department of Radiology, Massachusetts General Hospital, Boston, Mass. Accepted for publication in March 1955.

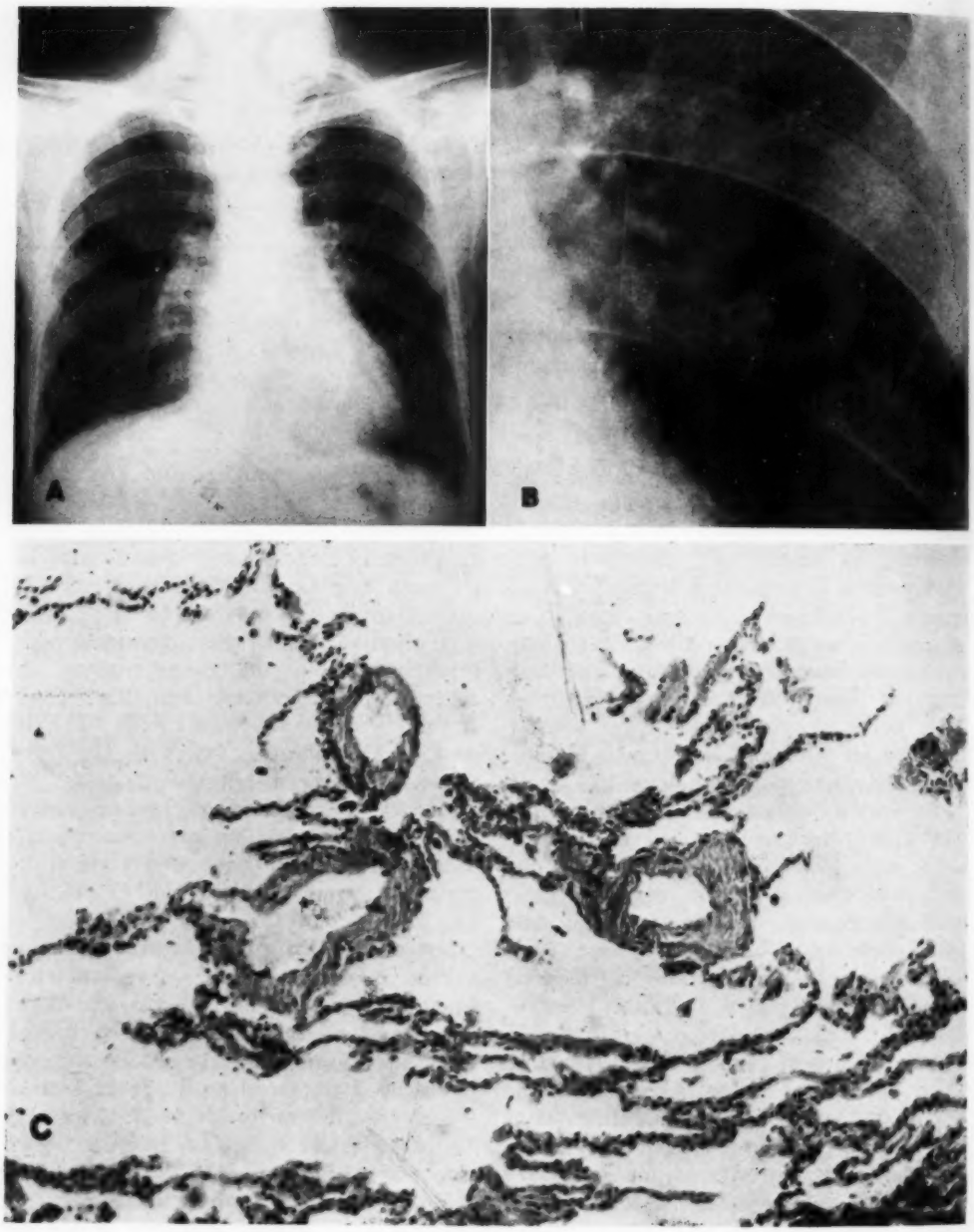


Fig. 1. Case I: Amyloidosis of lungs and heart.

A. Roentgenogram of the chest showing increase of pulmonary markings throughout, with minimal stippling of the peripheral lung fields. The heart was moderately enlarged, without specific configuration.

B. Close-up view of the left lower lung.

C. Photomicrograph of the lung showing abundant amyloid deposit around blood vessels.

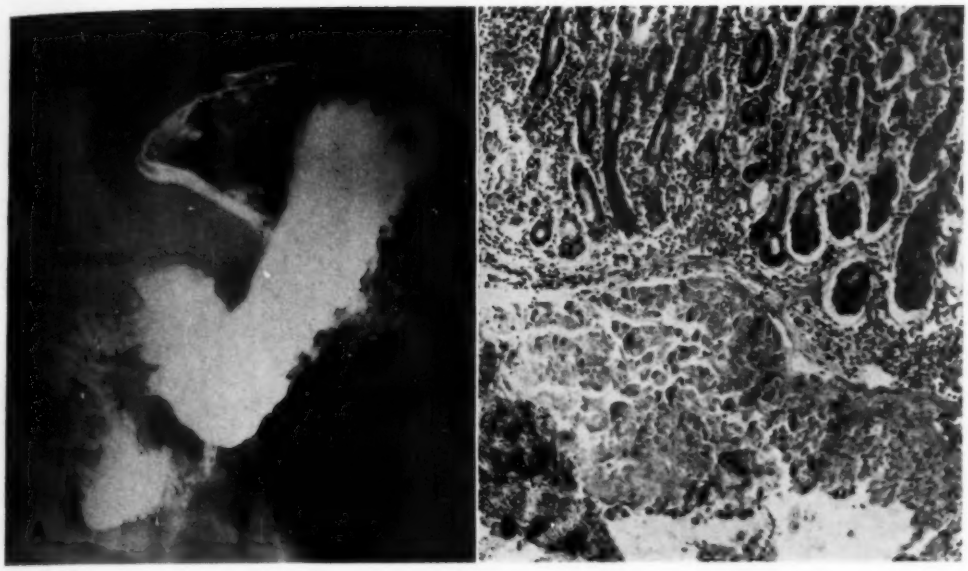


Fig. 2. Case I: Amyloidosis of stomach.
A. Gastrointestinal series showed marked thickening of the gastric rugae with diminished peristaltic waves across the stomach; marked irregularity along the greater curvature suggesting multiple filling defects.
B. Photomicrograph showing extensive amyloid deposit in the submucosal layer of the gastric wall.

certain electrocardiographic changes, until late in the process, when decompensation becomes intractable. Involvement of the lungs rarely gives rise to symptoms until the infiltration becomes massive, when progressive shortness of breath develops.

MATERIAL

Amyloid disease, either primary or secondary, involving various organs was found in approximately 110 cases among 17,580 autopsies (0.63 per cent) performed at the Massachusettts General Hospital during the past sixty years. From 1945 to 1954 a total of 29 cases of the disease came to autopsy. In 19 of this group roentgenograms were available for study. In addition there were 2 cases in which roentgen studies had been made in this hospital, although the patients were autopsied elsewhere. Of the total of 31 cases, 8 were primary, 3 were associated with multiple myeloma, and 20 were of the secondary type. Ten of the secondary group were associated with rheumatoid arthritis; the remainder with Hodgkin's lymphoma, tuberculosis, bronchiectasis, and ulcerative colitis in approximately equal proportion. This material constituted the basis of the present investigation.

CASE REPORTS

Seven cases are presented to illustrate the various roentgenologic manifestations of the disease.

CASE I: A 59-year-old white man was admitted to the hospital in August 1945 with a two-year history of fatigability, epigastric distress, gaseous eructations, and progressive hoarseness. One year before admission a gastrointestinal series had demonstrated an ulcer in the first portion of the duodenum, with marked pyloric spasm. Nine months before entry the patient had noticed shortness of breath and enlargement of the tongue and cervical lymph nodes, with marked edema of the face, arms, and legs. A biopsy from the larynx showed amyloidosis. On two occasions a Congo red test had been negative.

Roentgen Examination: Roentgenograms of the chest disclosed some increase in the prominence of the pulmonary markings, with tiny nodular densities throughout. The heart was enlarged (Fig. 1). A gastrointestinal series (Fig. 2) revealed marked thickening of the gastric rugae, with considerable delay in emptying. Irregularity along the greater

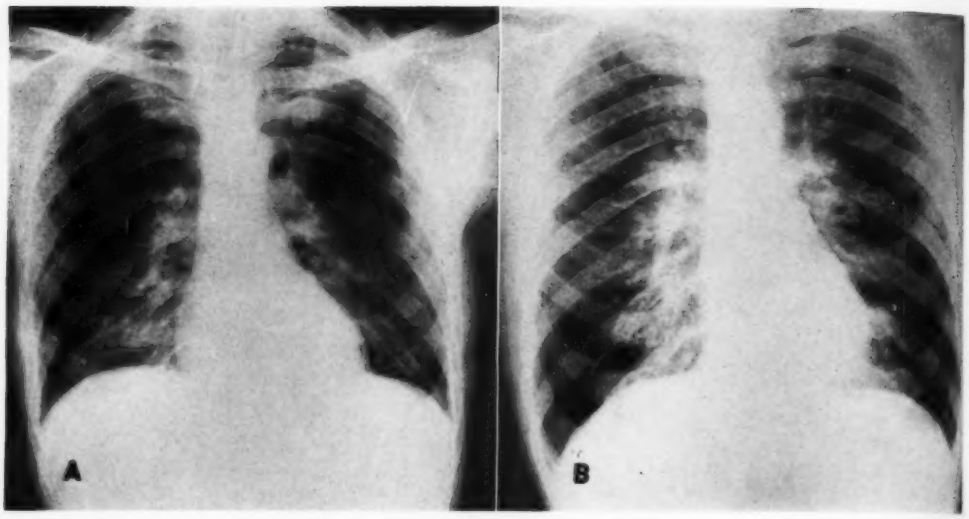


Fig. 3. Case II: Amyloid disease of lung.
A. Roentgenogram of the chest in 1943, considered normal.
B. In 1946, multiple tiny nodular densities were first noted in both lung fields, and the pulmonary markings were prominent.

curvature side suggested the possibility of multiple filling defects. It was observed fluoroscopically that gastric peristalsis was irregular and sluggish. A large gastric residue was noted six hours after the barium meal. The folds of the duodenum were thickened.

Abdominal exploration was carried out elsewhere. The patient subsequently died and postmortem examination was performed.[2]

Postmortem Examination: The intestinal walls were found to be markedly thickened, with numerous nodules, 1 to 3 mm. in diameter, resembling tubercles, on the serosal surface. The heart weighed 470 gm.; the valves were thickened and distorted. The myocardium presented a pale translucent appearance. The right lung weighed 500 gm., the left 550 gm. Microscopically, there were massive deposits of amyloid in the tongue, larynx, myocardium, submucosa, and muscularis of the gastrointestinal tract. Abundant amyloid was observed around the pulmonary blood vessels (Fig. 1C). There was no involvement of the liver, spleen, kidneys, or adrenal glands.

Anatomic Diagnosis: Primary amyloidosis of the lungs, heart, gastrointestinal tract, tongue, and larynx.

CASE II: A 50-year-old man was admitted in March 1943, with a long history of epigastric distress which had led to a diagnosis of duodenal ulcer. In 1938, he had suffered a severe gastric hemorrhage. In January 1945, gastrotomy and biopsy revealed a lesion involving the upper two-thirds of the stomach. The histologic diagnosis was malignant lymphoma of the lymphoblastic type. Postoperatively, a course of external radiation consisting of approximately 1,000 r (supervoltage x-ray) to the stomach, over a period of three weeks, was given. After irradiation, the gastric symptoms improved, although there were intermittent mild recurrences.

Roentgen Examination: In 1943, the roentgen appearance of the chest was normal. In 1946, multiple tiny nodular densities were evident throughout the lung fields and the vascular markings were increased. In 1949, the pulmonary changes had progressed strikingly, but both bases were relatively clear. Hilar lymph nodes were enlarged. In 1950, films revealed conglomeration of the nodular densities, particularly pronounced in the right upper lobe (Figs. 3 and 4).

A gastrointestinal series, in 1943, showed marked thickening of the mucosa in the proximal half of the stomach. In 1947, following roentgen therapy, the gastric folds had been remarkably reduced in size, but remained prominent along the greater curvature (Fig. 5).

Course: In 1950, on the assumption that the pulmonary lesions might be part of the old lymphomatous process, the patient was given 2,000-kv x-ray therapy—900 r (air dose) to the chest in a ten-day period. He had received a course of nitrogen mustard in 1949. No improvement followed either treatment. Death occurred in February 1952 as a result of pulmonary difficulty.

Postmortem Examination: (Performed by Dr. Herbert Fanger, of Providence, R. I.): Grossly, the right lung weighed 3,190 gm., and the left 3,100 gm.;

[2] Reported by DEWOLF, H., AND CLARKE, B. E.: Am. J. Clin. Path. **20**: 165, 1950.

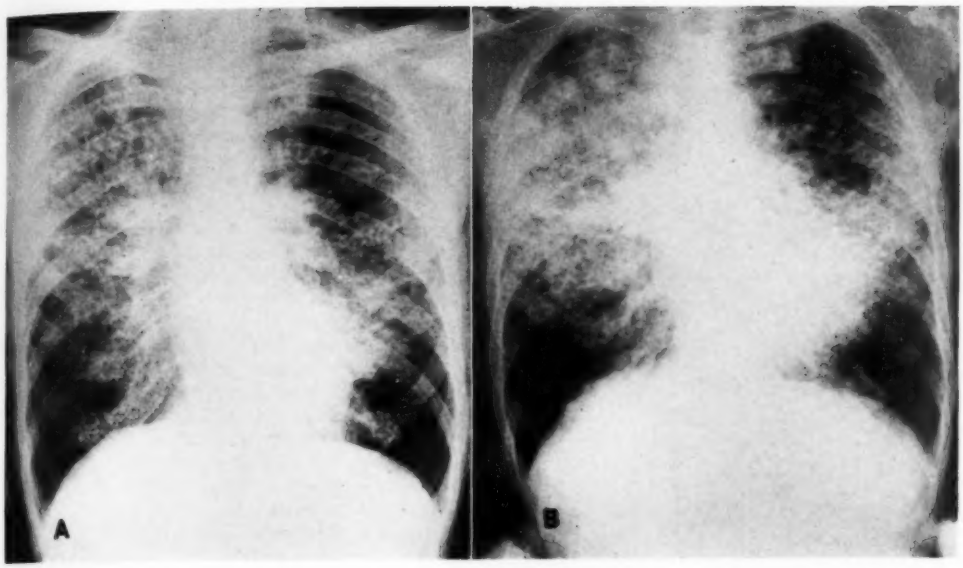


Fig. 4. Case II: Amyloid disease of lung.

A. Roentgenogram obtained in 1949, showing marked progression of the pulmonary lesions, with enlarged hilar shadows.

B. In 1950, striking confluence of the nodular densities, particularly in the right upper lobe, had taken place

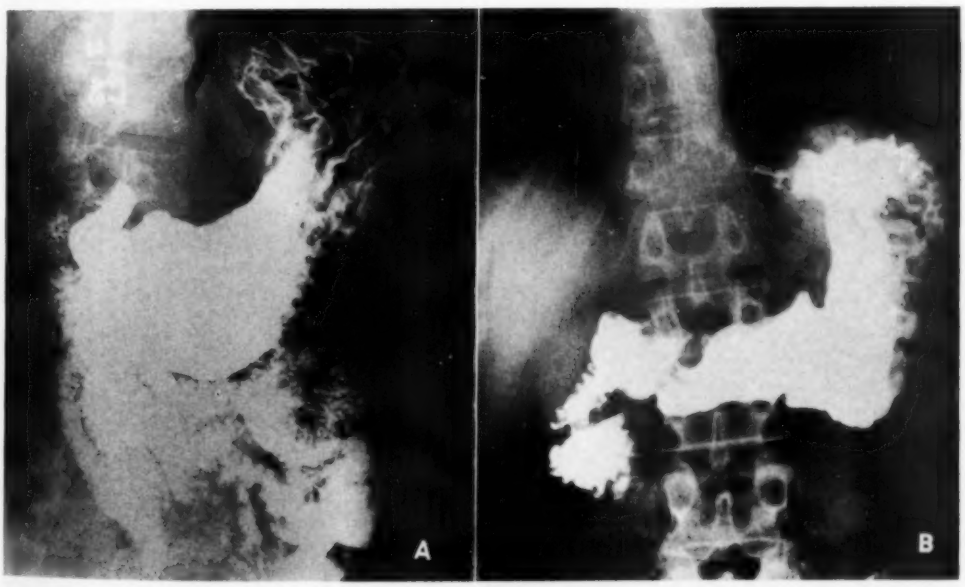


Fig. 5. Case II. Amyloidosis and lymphoma of stomach.

A. A gastrointestinal series in 1943 showed extremely prominent gastric folds in the proximal half of the stomach, without evidence of ulceration.

B. In 1947, following x-ray treatment, the size of the gastric folds was reduced, but the rugae along the greater curvature side remained prominent.

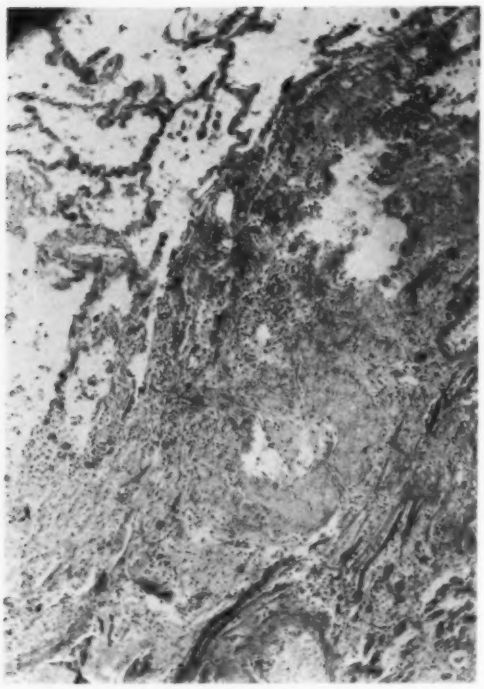


Fig. 6. Case II: Photomicrograph of lung section demonstrating large amount of amyloid in the interstitial tissues, replacing the normal pulmonary structure.

they were completely devoid of air. The pleural surfaces were smooth and of a pink-yellow color, with a solid waxy appearance. The elasticity of the lung was virtually destroyed. The wall of the stomach was markedly thickened and of fibrotic consistency. The mucosa contained numerous yellowish-gray nodules measuring up to 4 mm. in diameter, with petechial hemorrhages. In the small intestine the mucosa was prominent and thickened.

Microscopic sections of the lungs showed patchy areas of destruction of the normal tissues by an amorphous, faintly pink-staining material. Only islands of intact lung parenchyma remained. The capillaries and the blood vessels were severely congested and were heavily infiltrated by amyloid (Fig. 6). In sections of the stomach the mucosa was distorted and the wall filled with thick amyloid. (Review of the original microscopic sections of the stomach, made in 1945, confirmed the original diagnosis of lymphoma but disclosed, in addition, amyloid deposit.) Similar changes were also seen in the duodenum.

Anatomic Diagnosis: Amyloidosis of the lungs, larynx, stomach, intestine, and lymph nodes.

CASE III: A 46-year-old white male was admitted to the hospital in November 1947 with a four-year history of infrequent attacks of pain in the upper and lower extremities, accompanied by slight elevation of temperature and recent weight loss. There had been no gastrointestinal symptoms, although routine x-ray examination in a search for cancer had shown an ulcerating lesion in the prepyloric region, with marked antral spasm (Fig. 7).

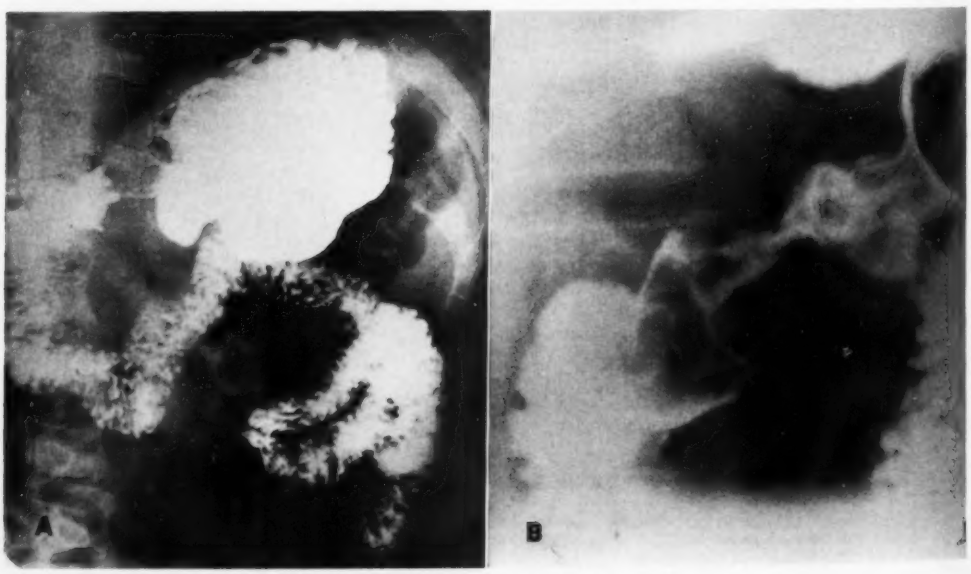


Fig. 7. Case III: Amyloidosis of stomach.
A. Gastrointestinal examination showed an ulcerating lesion in the prepyloric region with marked antral spasm.
B. Spot film of the same area.

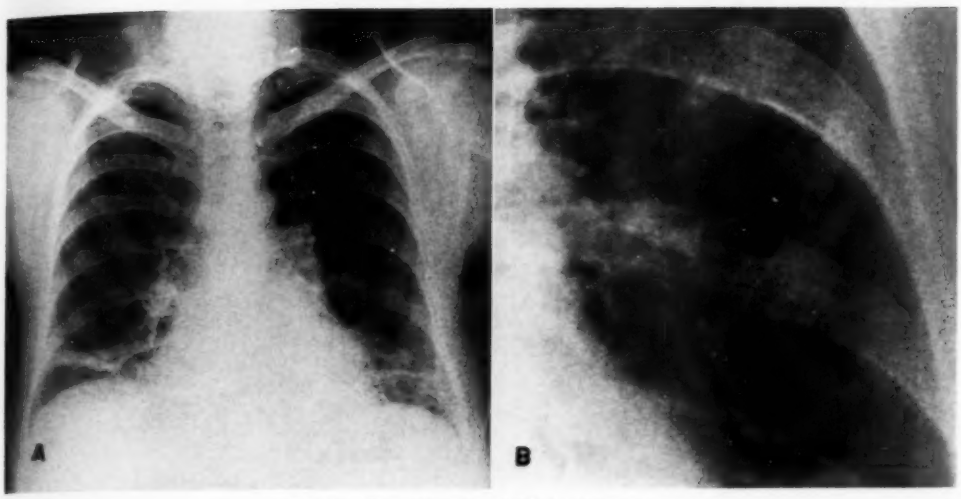


Fig. 8. Case IV: Amyloidosis of lungs.
A. Roentgenogram of the chest showing a few atelectatic bands in both bases, increased prominence of pulmonary markings, and stippling of the peripheral lung fields. The heart was enlarged.
B. Close-up view of the left lower lung.

The patient's condition precluded surgery; his course was downhill, with persistent fever and constant muscular pain. Terminally, there was bloody diarrhea, with markedly diminished urinary output.

Postmortem Examination: On gross inspection the gastric lesion appeared to be an old, partially healed peptic ulcer, close to the pylorus. Microscopic study revealed a considerable amount of amyloid deposit at the base of the ulcer. Amyloid infiltration was also present around the small blood vessels of the submucosa of the small and large intestine.

Anatomic Diagnosis: Amyloidosis involving the stomach, intestine, liver, spleen, and kidneys, in conjunction with multiple myeloma.

CASE IV: A 41-year-old woman was admitted to the hospital in December 1949 with a history of numbness in the hands for five months, abdominal swelling for two months, and 25 pounds weight loss. She had also experienced dyspnea on exertion. Physical examination revealed enlarged lymph nodes in both axillae and cervical regions. Fluid was present in the right pleural cavity, and ankle edema was noted. The abdomen was protuberant, with a large mass filling the right upper quadrant.

Laboratory findings were as follows: white blood cell count 18,600; hemoglobin 9 gm.; total serum protein 5.5 gm./100 c.c.; Congo red test negative; 4+ albumin in the urine. Bone marrow aspiration yielded 2 per cent plasmacytes and 5 per cent normoblasts. Liver biopsy showed amyloid disease.

Roentgen Examination: A few atelectatic bands were demonstrated in both lung bases, and pulmonary markings were increased throughout. There was some stippling of the peripheral lung fields (Fig. 8). The heart was enlarged. A gastrointestinal series showed prominence of the gastric rugae and marked thickening and widening of the mucosal folds of the slightly dilated duodenum and upper jejunum (Fig. 9).

Course: A productive cough developed in February 1950, and diarrhea ensued, with bowel movements five times daily. The patient's condition became gradually worse, and death occurred in May 1950.

Postmortem Examination: The presence of multiple myeloma and amyloidosis was confirmed postmortem. On gross examination the walls of the jejunum and ileum were stiff and tended to retain their shape even after being opened, suggesting infiltration into the bowel wall. No ulceration was demonstrated. Microscopic examination showed amyloid deposit in the walls of the blood vessels, in the mucosa, and in the muscular coat of the small intestine.

Anatomic Diagnosis: Multiple myeloma with amyloidosis involving the lung, heart, blood vessels, liver, spleen, and small intestine.

CASE V: A 40-year-old white male known to have Hodgkin's lymphoma was admitted to the hospital in July 1949. He had received multiple roentgen-ray treatments to the neck, abdomen, and groin over the preceding ten years. In July 1949, the Congo red test was strongly positive for amyloid disease.

Roentgen examination showed a markedly dilated stomach without intrinsic defects; the duodenum was dilated and hypotonic. Films obtained two days later demonstrated many dilated loops of small bowel containing dilute barium from the previous examination. There was little gas in the colon. The

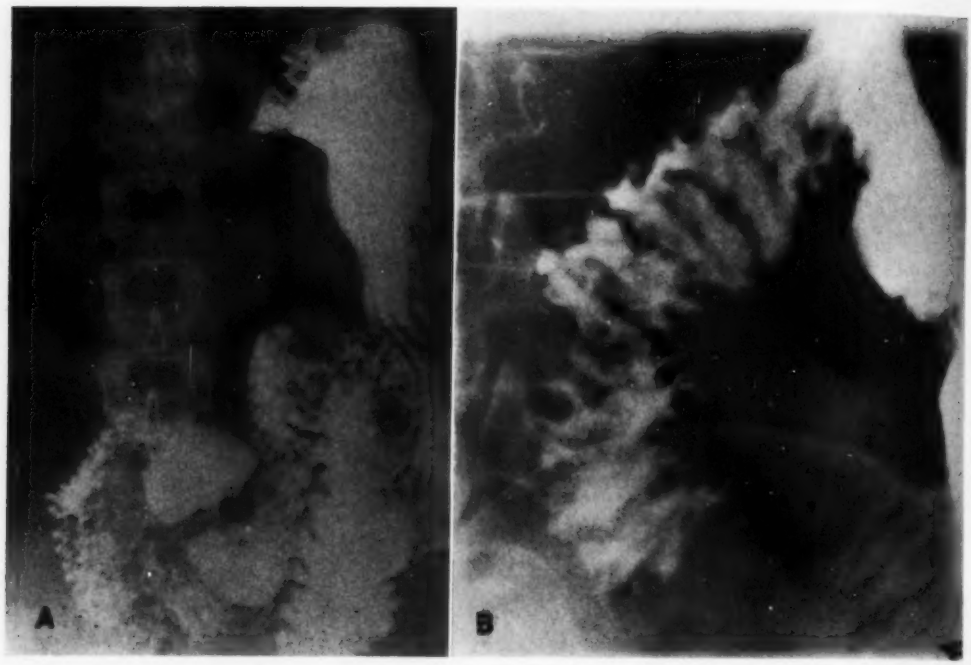


Fig. 9. Case IV: Amyloidosis of small bowel.
A. Gastrointestinal series showing marked thickening and widening of the mucosal folds of the duodenum and upper jejunum. The intestinal lumen was somewhat dilated.
B. Spot film of the duodenal loop to show the mucosal pattern.

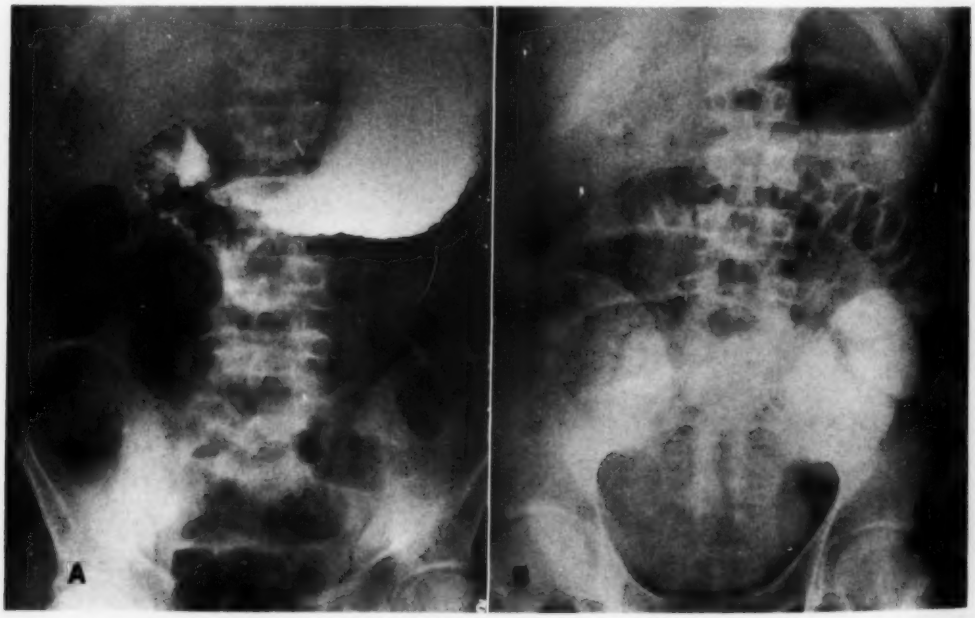


Fig. 10. Case V: Amyloid disease of small bowel.
A. Roentgenogram of the upper gastrointestinal tract demonstrating a gas- and barium-filled stomach. Gas was scattered through the small and large bowel. The duodenum was dilated and hypotonic.
B. Roentgenogram of the abdomen taken two days later, showing many dilated loops of small bowel containing diluted barium from the previous gastric examination.

appearance was that of ileus of the small bowel (Fig. 10).

Course: The patient suffered increasingly severe epigastric discomfort and abdominal distention and died on July 24, 1949.

Postmortem Examination: The intestine was markedly distended and showed scattered areas of hemorrhage but no ulceration. Microscopically, there was a considerable amyloid deposit in the blood vessels, submucosa, and muscularis of the small bowel.

Anatomic Diagnosis: Malignant lymphoma, Hodgkin's type. Secondary amyloidosis of small intestine, lymph nodes, liver, spleen, kidneys, and adrenals.

CASE VI: A 49-year-old man was admitted to the hospital in March 1947 because of epigastric pain of seven months duration. There had been no bleeding, constipation, or shortness of breath. The patient was subject to purpura. Physical examination showed ecchymoses of the skin and mucous membrane. Laboratory studies revealed elevated serum amylase. A diagnosis of pancreatitis was made.

Roentgen Examination: The pulmonary vessels appeared to be somewhat congested. There was a considerable amount of fluid in both pleural cavities, and the heart was enlarged (Fig. 11). A barium enema study showed widening and thickening of the mucosal folds throughout the large bowel, with no indication of ulceration. Fixation of the entire colon was evident (Fig. 12).

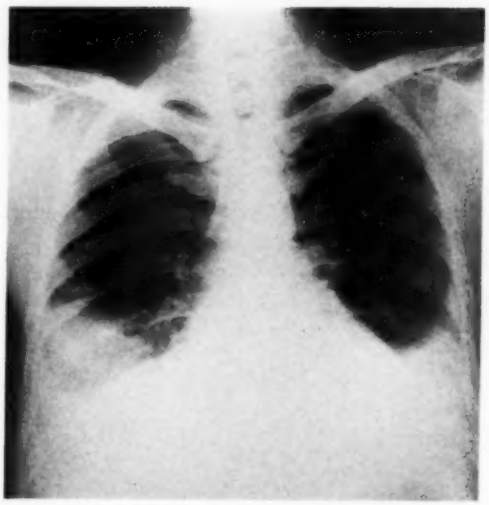


Fig. 11. Case VI: Amyloidosis of heart. Roentgenogram of the chest showing pulmonary congestion, cardiac enlargement, and bilateral pleural fluid.

At *laparotomy* no condition correctable by surgery was found and no diagnosis could be made. The patient died two days later.

Postmortem Examination: The lungs weighed

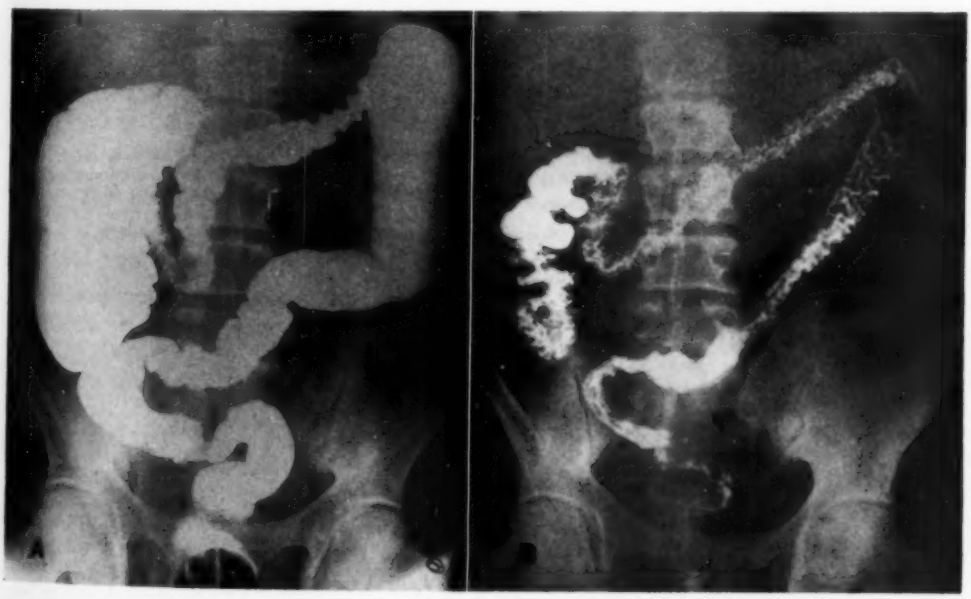


Fig. 12. Case VI: Amyloid disease of colon.
A. Barium enema showing some fixation of the left colon, with slight irregularity of the distal transverse colon near the splenic flexure, but no ulceration.
B. Postevacuation film demonstrating marked swelling of the mucosal folds throughout.

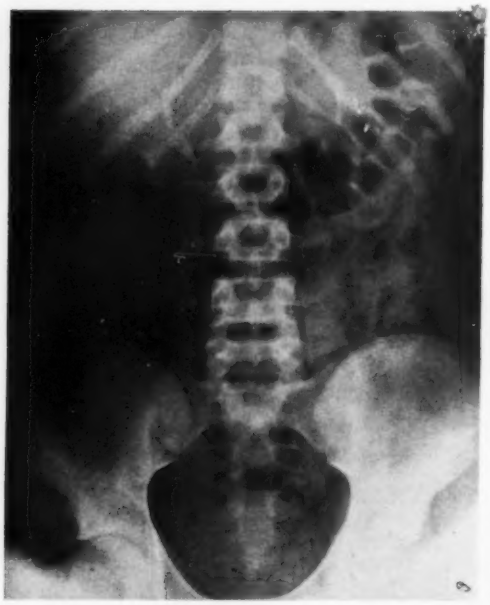


Fig. 13. Case VII: Amyloidosis of kidney. Intravenous urogram showing moderately enlarged kidneys, with slight impairment of excretion of the contrast medium. The collecting system was not deformed and the renal outlines were smooth.

1,430 gm. and the vessels were markedly congested. The heart weighed 490 gm. The myocardium was thickened. Microscopic examination revealed extensive myocardial deposits of amyloid, resulting in degeneration of the muscle. In the lungs the thickened alveolar walls and the small blood vessels contained collars of amyloid. There were sizable areas of recent hemorrhage in the colon, with a considerable amount of amyloid deposition around the walls of the small blood vessels in the submucosal region.

Anatomic Diagnosis: Primary amyloidosis involving heart, lungs, lymph nodes, large intestine.

CASE VII: A 12-year-old boy was admitted to the hospital Aug. 24, 1946, with a history of rheumatoid arthritis of approximately six years duration. There had been two episodes of gross hematuria. On admission laboratory studies revealed a reverse albumin-globulin ratio. The Congo red test was strongly positive for amyloid disease. The urine showed a specific gravity of 1.012, 3+ albumin, and an occasional white blood cell. The non-protein nitrogen in the blood rose steadily, and death occurred from uremia on Oct. 22, 1946.

Roentgen Examination: An intravenous urogram had shown considerably enlarged, smooth kidneys, with some impairment of excretion of the contrast medium. The collecting system, however, revealed no abnormality (Fig. 13).

Postmortem Examination: The kidneys were strikingly enlarged, weighing 450 gm., pale yellowish-brown in color, and of firm consistency. The cortices were bulging and waxy in appearance, varying in thickness from 0.8 to 2.0 cm. with marked amyloid deposition. The vessels in the renal substance also showed amyloid deposits.

Anatomic Diagnosis: Secondary amyloidosis involving the kidneys, spleen, liver, and lymph nodes, associated with rheumatoid arthritis.

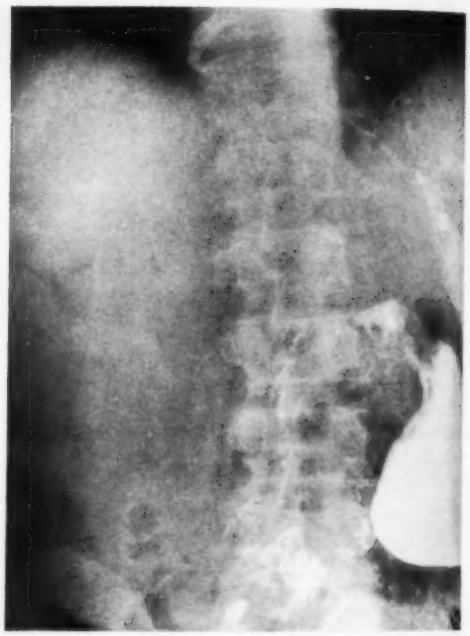


Fig. 14. Amyloid disease of liver. Roentgenogram of the right upper quadrant of the abdomen demonstrating the markedly enlarged liver and deformity of the duodenal cap secondary to ulceration.

DISCUSSION

Successful treatment of amyloidosis lies in the eradication of the basic associated disease. It has been reported (7, 12) that regression of clinical signs and symptoms has been produced by the oral administration of powdered whole liver. It is therefore apparent that early recognition of the disease, with appropriate therapy, is a practical and not merely an academic problem.

The roentgenologic manifestations of amyloid disease vary, depending upon the amount and location of infiltration in the particular organs involved. When there was considerable deposition of amyloid in

the liver and spleen, as commonly seen in secondary amyloidosis, the organs were generally enlarged (Figs. 14 and 15). Of the entire group of 110 cases, 75 per cent showed amyloid in the kidneys and spleen on pathologic examination. In 5 of 7 cases in which amyloid was proved to be present in the spleen there was roentgenographic evidence of moderate splenomegaly. When the kidneys were chiefly involved, enlargement was accompanied by functional impairment without noticeable distortion of the collecting system (Case VII).

In the early phases of the disease, the lungs showed no discernible roentgen abnormality. In 6 of 9 cases in which pulmonary amyloid was present (6 primary, 2 with multiple myeloma, and 1 secondary to rheumatoid arthritis), there was radiographic abnormality in the peripheral lung fields. This consisted in increased prominence of the bronchovascular markings with inconspicuous stippling when the blood vessels were chiefly involved (Cases I and IV). In the late stages, when there was actual deposition of amyloid in the interstitial tissues, the appearance was that of a miliary process, such as is seen in miliary tuberculosis, silicosis, sarcoidosis, and granulomatous disease (Case II and Case IV). In severe cases, the pulmonary findings at times mimicked lymphatic spread of a malignant growth (Case II). Evidence of hilar adenopathy was discernible when the lymph nodes were enlarged by amyloid. These pulmonary changes were somewhat similar to but more striking than those which have been reported elsewhere in the literature (2, 10).

Massive infiltration of amyloid in the heart produced gross enlargement followed by congestive failure (1). Six of 8 cases with amyloid in the myocardium (6 primary, 2 associated with multiple myeloma) showed cardiac enlargement (Cases I and IV) and 4 of the 6 patients with primary amyloidosis were in cardiac decompensation (Case VI).

The gastric manifestations of amyloid disease, consisting of ulceration, tumor formation, hypertrophy of gastric folds, and pyloric stenosis, have been reported (2, 4, 11). As a result of mucosal and submucosal amyloid deposition, Cases I and II showed greatly thickened gastric rugae with decreased flexibility and motility simulating severe gastritis, superficial carcinoma, and lymphoma. In Case III a prepyloric ulcer with considerable deformity of the antrum radiographically resembled malignant ulceration. Pathologically, a large amount of amyloid was demonstrated at the base of this ulcer. It is debatable whether the ulcer was secondary to amyloid deposition or was purely coincidental.

In 6 of the 10 patients with amyloid disease associated with rheumatoid arthritis, gastrointestinal roentgenologic examination was performed. It seems remarkable that in 5 of the 6, roentgenographic and pathologic evidence of peptic ulceration was disclosed (2 gastric, 3 duodenal). The exact relationship, if any, between amyloid disease and peptic ulcer is obscure.

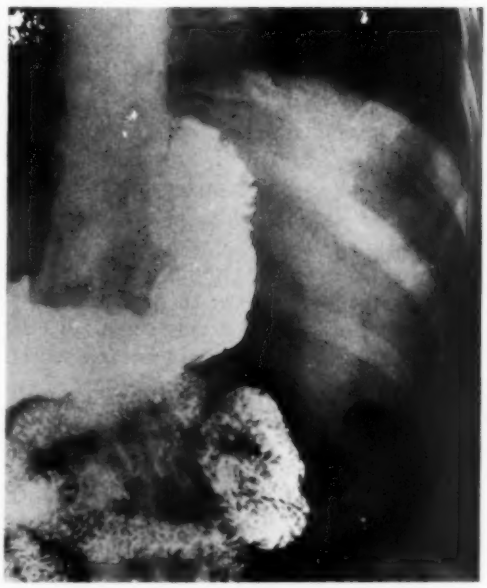


Fig. 15. Amyloidosis of spleen. Roentgenogram of the left upper quadrant showing moderate splenomegaly.

In the small intestine, amyloid deposition caused increased widening and separation of the mucosal folds, with some dilatation of the intestinal lumen (Case IV). Severe amyloid disease in the small bowel produced impairment of intestinal motility and a radiographic appearance of ileus, occasioning considerable difficulty in differentiation from obstruction due to other causes (Case V). Similar observations have been reported by others (5, 6).

It is difficult to decide whether the changes noted in the large bowel (Case VI), *i.e.*, thickening of the mucosal folds simulating early ulcerative colitis, were due solely to amyloid deposits, to submucosal hemorrhage, or to both (8).

Not one of the 3 cases of amyloidosis associated with multiple myeloma showed roentgenographic evidence of skeletal abnormality.

It is to be noted that the roentgen changes described in various organs are not pathognomonic of amyloid disease. In a patient exhibiting one of the basic conditions frequently associated with secondary amyloidosis, however, these roentgen findings together with the clinical data and results of laboratory tests may lead to a correct diagnosis. The recognition of primary amyloidosis is difficult, but the diagnosis may be suggested roentgenologically and confirmed by tissue biopsy.

SUMMARY

A roentgenologic study of 21 cases of amyloid disease involving lungs, heart, gastrointestinal tract, kidneys, spleen, and liver is presented.

The roentgen changes depend upon the amount and location of amyloid infiltration in the system; they are not pathognomonic but may be suggestive of the disease.

Massachusetts General Hospital
Boston 14, Mass.

REFERENCES

1. BINFORD, C. H.: Primary Amyloid Disease of the Myocardium and Blood Vessels. Report of a Case with Death from Myocardial Failure. Arch. Path. **29**: 314–320, March 1940.

2. COOLEY, R. N.: Primary Amyloidosis with Involvement of the Stomach. Am. J. Roentgenol. **70**: 428–436, September 1953.

3. DIRKSE, P. R.: Primary Amyloidosis of the Lungs. Am. J. Roentgenol. **56**: 577–585, November 1946.

4. GOLDEN, A.: Primary Systemic Amyloidosis of the Alimentary Tract. Arch. Int. Med. **75**: 413–416, June 1945.

5. GOLDEN, R.: Radiologic Examination of the Small Intestine. Philadelphia, J. B. Lippincott Co., 1945, pp. 215–216.

6. GOLDEN, R.: Amyloidosis of the Small Intestine. Am. J. Roentgenol. **72**: 401–408, September 1954.

7. GRAYZEL, H. G., AND JACOBI, M.: Secondary Amyloidosis. Results of Therapy with Desiccated Whole Liver Powder. Ann. Int. Med. **12**: 39–58, July 1938.

8. HEEREN, J. G.: Das Röntgenbild der Amyloidose des Dickdarms. Röntgenpraxis **13**: 176–178, May 1941.

9. MACCALLUM, W. G.: A Text-Book of Pathology. Philadelphia, W. B. Saunders Co., 1928. (Quoting Rokitansky)

10. SAPPINGTON, S. W., DAVIE, J. H., AND HORNEFF, J. A.: Primary Amyloidosis of the Lungs. J. Lab. & Clin. Med. **27**: 882–889, April 1942.

11. SHIPPS, F. C., AND BRANNAN, D. D.: Roentgenological Findings in Amyloidosis of Stomach. Am. J. Roentgenol. **68**: 204–208, August 1952.

12. TRASOFF, A., SCHNEEBERG, N., AND SCARF, M.: Recovery from Multiple Rheumatoid Arthritis Complicated by Amyloidosis in a Child. Report of a Case and Review of the Literature. Arch. Int. Med. **74**: 4–10, July 1944.

13. VIRCHOW, R.: Cellular Pathology, American Edition, New York, Robert M. Dewitt, 1858.

SUMARIO

La Amiloidosis; Sus Manifestaciones Roentgenológicas

Preséntase un estudio radiológico de 21 casos de enfermedad amiloidea, con inclusión de 7 típicas historias clínicas (en todas las cuales hubo un desenlace letal).

La amiloidosis primaria es relativamente rara; se deposita el amiloide en los pulmones y el corazón y en los vasos sanguíneos por todo el cuerpo, encontrándose menos frecuentemente en el bazo y el tubo gastrointestinal. La dolencia no se vincula con sepsis crónica ni con ningún otro factor etiológico conocido. El amiloide no absorbe siempre los colorantes habituales, tales como rojo del Congo, yodo o violeta de metilo. Raramente se observa en un órgano dado un depósito solitario.

La amiloidosis secundaria, la forma más común de la enfermedad, suele asociarse con infecciones y procesos histolíticos de mucha duración, tales como artritis reumatoidea, bronquiectasia, tuberculosis y tumores malignos. El amiloide absorbe bien los colorantes y casi siempre se deposita en el hígado, el bazo, los riñones y las suprarrenales.

Una forma especial de amiloidosis asociada con mieloma múltiple suele conformarse al patrón de distribución y a la variabilidad de la reacción tintorial observados frecuentemente en la amiloidosis primaria.

Las alteraciones radiológicas dependen de la proporción y la localización de la infiltración amiloidea en el organismo; no son patognomónicas pero pueden ser indicativas de la enfermedad. Comprenden la hipertrofia de un órgano dado, insuficiencia functional en casos de invasión renal, mayor proyección de las marcas broncovasculares o aspecto parecido al de un proceso granúlico en la amiloidosis pulmonar y ulceración, tumorigenia, hipertrofia de los repliegues gástricos y estenosis pilórica cuando está afectado el tubo digestivo.

El tratamiento de la amiloidosis secundaria radica en la erradicación de la enfermedad fundamental asociada.

Renal Papillary Necrosis[1]

JOHN A. EVANS, M.D., and WAYNE D. ROSS, M.D.

RENAL PAPILLARY necrosis, called also necrosis of the renal papillae, necrotizing papillitis, and papillitis necroticans, is an uncommon condition, usually found in diabetic patients, although it may occur in non-diabetics. It has been recognized pathologically for many years, having been first described by von Friedreich in 1877 (1). Since that time 181 cases have been recorded, of which only 10 per cent failed to show evidence of diabetes, obstructive uropathy, or both (2). Because this disease is not well known, usually being discovered unexpectedly at necropsy, it is felt worthwhile to report a single case diagnosed radiographically during life. To our knowledge there has been no previous report of this type in the radiological literature. Olsson (3) in 1939 presented a case diagnosed by a gas pyelogram obtained as a result of fermentation of sugar in the urine of a diabetic. In 1945 Eskelund (4) published a case of necrotizing papillitis of the kidney following retrograde pyelography in a fifty-five-year-old female with pyelonephritis who died in a state of uremia, the diagnosis being based on postmortem examination.

In spite of the high mortality in these cases, the correct antemortem diagnosis is of more than academic interest, since the disease has two important characteristics that require a proper therapeutic regimen: (1) It is a suddenly developing and rapidly progressing necrotizing bacterial lesion that must be treated aggressively and without delay. (2) The selective necrosis involving the tips of the papillae impairs the urinary drainage of the associated nephrons, making definitely hazardous the use of sulfonamide drugs and related compounds with their known tendency to precipitate out in the renal tubules under conditions of urinary stasis or acid-base imbalance. Recent reports by Harrison and Bailey (5), Robbins, Mallory, and Kinney (6), Edmunson, Martin, and Evans (7), Robbins and Angrist (8), Muirhead, Vanatta, and Grollman (9), Swartz (10), and Garrett, Norris, and Vellios (11) all add emphasis to these points.

CASE REPORT

A 55-year-old non-diabetic white male was admitted to the New York Hospital because of intermittent hematuria of three months duration. Cystoscopy revealed bleeding from the left ureteral orifice and poor function on the right. A right ureteral obstruction at 15 cm. was noted, together with an edematous and hemorrhagic appearing bladder mucosa. Blood clots were passed frequently. A chest film was negative for evidence of pulmonary disease. Blood pressure on admission was 180/110. The blood chemistry was within normal limits. Urine cultures yielded alpha *Streptococcus*, hemolytic *Streptococcus*, *Staphylococcus aureus*, and *Corynebacterium*. Smears and cultures on three separate occasions were negative for acid-fast bacilli. Intravenous and retrograde pyelograms taken at approximately two-week intervals showed progressive destruction of the fornices of the renal calyces bilaterally (the roentgen features will be considered in more detail below).

The clinical course was steadily downhill and the patient died in uremia one month following his admission to the hospital.

At necropsy the kidneys were found to weigh 700 gm. and were slightly enlarged. The capsule of the left kidney stripped with ease except at the upper pole, where several gray nodules measuring up to 5 mm. in diameter, with necrotic centers, bound capsule and cortex together. The capsule of the right kidney was firmly adherent and stripped with great difficulty. On gross section both kidneys were uniformly pale. The distal portions of the papillae of both were necrotic and had sloughed. The calyces and pelves were greatly thickened, rough, and distended by a mass of heavy sand-like necrotic material and sanguineous fluid. The mucosal surface of the ureters was similarly involved. The lumens were filled with particulate material, and were dilated, measuring approximately 2 cm. in circumference. The right ureter showed an S-shaped curve

[1] From the Department of Radiology, The New York Hospital-Cornell Medical Center. Accepted for publication in March 1955.

6 cm. below the pelvis, but it was patent, as were both ureteral orifices. The bladder mucosa was hyperemic and contained some white granular necrotic material on its surface (Fig. 1).

Microscopic Description: On section the papillae throughout both kidneys were necrotic, hemorrhagic, and bordered by an area of polymorphonucleocytes and lymphocytes, plasma cells, and colonies of cocci and bacilli. Specially prepared sections for demonstration of acid-fast bacilli were entirely negative.

Anatomic Diagnosis: Acute bilateral pyelonephritis with necrotizing papillitis, ureteritis, and cystitis.

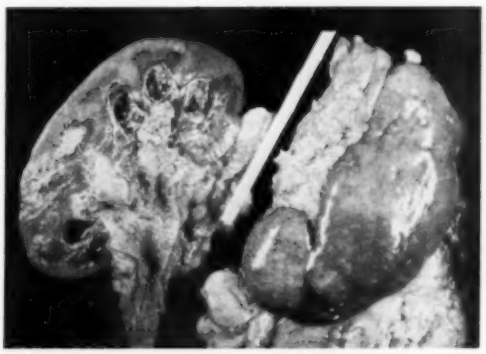


Fig. 1. Gross specimen. The renal papillae are necrotic and have sloughed. Calyces and pelves are dilated, thickened, and contain necrotic debris.

DISCUSSION

The gross and microscopic features of this entity have been well documented in the literature and have been shown to be remarkably constant, differing only slightly according to the stage of the disease at the time of pathologic examination. Also, the findings have been shown not to be influenced essentially by different etiologic organisms or by the presence or absence of diabetes.

Grossly, the earliest stage is characterized by scattered abscesses located in the renal pyramids. As the disease progresses, these abscesses become confluent, resulting in necrosis of the terminal two-thirds of the pyramid. The process is frequently but not always bilateral. In most instances all pyramids of the affected kidneys are involved. In advanced lesions, portions of the papillae break off into the lumen of the pelvis, and complete sequestration may occur, with sloughing of a whole papilla into the pelvis. Histologically, in the well advanced lesion, the papillae are completely involved.

The radiographic features of renal papillary necrosis have heretofore received little attention, mainly because of the obscurity and rarity of the disease entity. Alken (12) in 1938 reported on 4 patients (all diabetics) with papillary necrosis and remarked on the x-ray findings in 2. In 1 instance retrograde pyelography revealed an enlarged left renal shadow of irregular shape, with hazy outlines of the upper and lower calyces. Nephrectomy was performed and papillary necrosis noted. The second case showed an indistinct contour and a defect of the superior calyx. The diagnosis was suggested after the patient passed a papilla in the urine and histologic study was carried out. Harrison and Bailey presented roentgen findings in 1 of a series of 3 cases and remarked that the changes produced in the pyelogram by necrosis of the renal papilla bore a striking resemblance to those in renal tuberculosis.

The radiographic findings in this entity are the result of destruction of the papillae and/or the associated inflammatory process. The roentgen diagnosis is therefore dependent on the period or phase of the disease in which the examination is performed. A tabulation of the roentgen findings from the early to the late stages as reported in the literature and as observed in our own experience follows:

(1) Delay in or complete lack of function, most commonly unilateral, is probably the earliest roentgen finding.

(2) Mild to moderate dilatation of the collecting system may be seen. This may be limited to a single calyx, a group of calyces, or the entire collecting system. This sequence of events may be reversed if there is obstruction of the lower urinary tract.

(3) A mottled, moth-eaten appearance of the fornices occurs. This results from necrosis and sloughing of the renal papillae. In this respect the findings are similar to those seen in tuberculosis.

(4) Gross filling defects may be seen

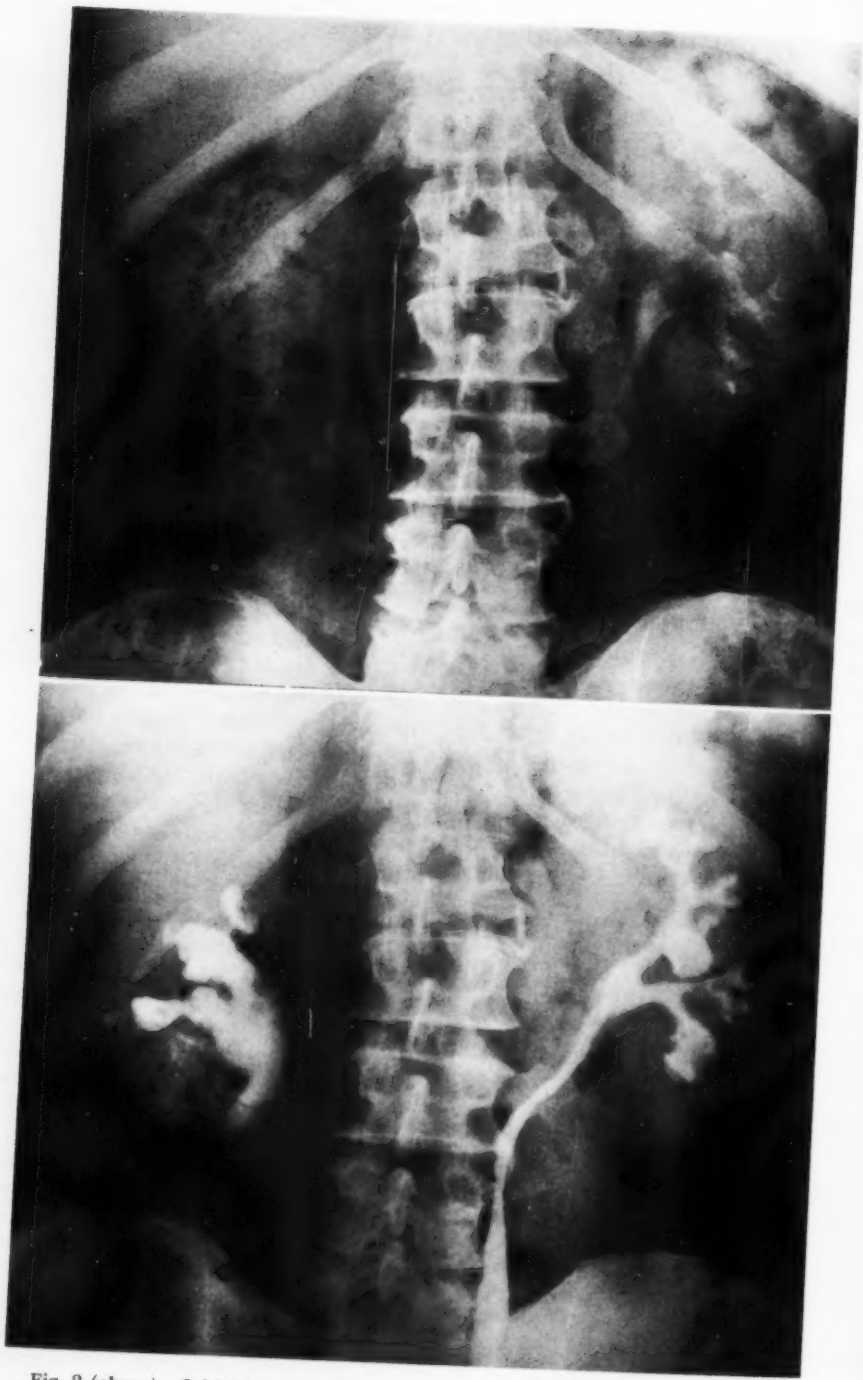


Fig. 2 (above). Initial intravenous pyelogram showing grossly normal left upper urinary tract and non-function of right kidney.

Fig. 3 (below). Retrograde pyelogram one week later. Calyectasis of left kidney with irregular filling of calyces, giving a blotchy appearance. The right kidney is hydronephrotic and also shows blotchy appearance of filled calyces.

throughout the calyces and pelvis, representing necrotic slough and blood clots.

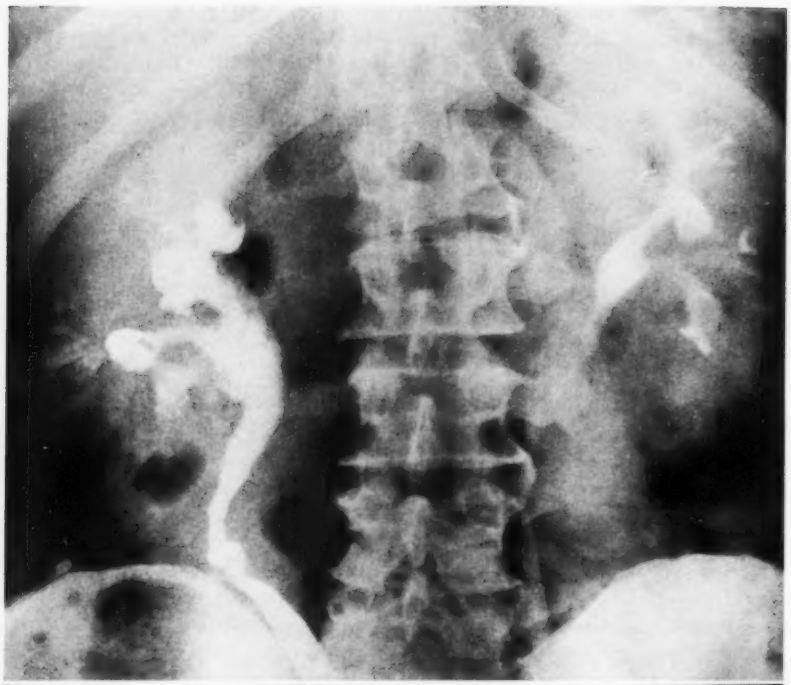
(5) An interesting phenomenon is the occurrence of "ring shadows." These are radiolucent halos rimming dilated calyces. The halos probably represent defects left by a sequestrated papilla and occur in an advanced stage of the disease. The presence of numerous "ring shadows" produces a striking radiographic picture.

(6) In advanced cases with peripheral necrosis and cavitation, the contrast material is seen to extravasate into the renal cortex. Occasionally a large portion of a pyramid may break off and float down to the renal pelvis, where it will produce a filling defect simulating a tumor or nonopaque stone. This latter finding was noted by Knutsen and his group (13) in 1 of 2 cases.

The progressive pathological nature of this disease is graphically reflected in the pyelographic examinations in our case. The earliest roentgen finding was significant delay in function of the right kidney; the left renal collecting system appeared normal (Fig. 2). Retrograde pyelography done a week later showed pronounced structural changes in both collecting systems. In the right kidney a Grade III hydronephrosis was demonstrated; in the left kidney there was generalized calyectasis with small filling defects in all calyces (Fig. 3). Of special interest was the right ureteral kink at the level of L-4, with dilatation above and below (Fig. 4). This finding certainly would be in keeping with the experience reported by Edmunson, Martin, and Evans and by Robbins, Mallory, and Kinney regarding obstructive changes in the lower urinary tract in nondiabetics. In an excretory pyelogram taken several weeks after the retrograde study, no change in the appearance of the left upper renal collecting system was evident. The right kidney now, as opposed to the initial study, showed prompt function (Fig. 5). Clinically, at this time the patient appeared to be better. Interval excretory pyelography shortly thereafter disclosed progression of the disease in the right kidney, with the two sides now presenting a similar radiographic appearance (Fig. 6). Excretory pyelography shortly before death demonstrated a striking new feature. This was the presence of lucent ring-like halos about the minor calyces (Fig. 7). This finding had previously been commented on by Günther (14) and Alken, who referred to the effect produced as a "ring shadow." We feel that it represents an advanced phase of the disease and indicates papillary necrosis.

DIFFERENTIAL DIAGNOSIS

The diseases to be considered in the radiographic differential diagnosis are renal tuberculosis, renal tumor, renal calculus associated with colic, and acute pyelonephritis without necrosis. Certainly early unilateral renal papillary necrosis may simulate tuberculosis of the kidney, especially when the changes are confined to one or several minor calyces. On occasion, a fulminating tuberculous infection involving both kidneys will produce a ragged, moth-eaten appearance of the calycine system and defy differential diagnosis. The occurrence of both tuberculosis and renal papillary necrosis has been reported in a single case by Edmunson, Martin, and Evans, who considered it extremely rare. Suspicion of a renal tumor might be justified early in the disease, and differentiation on roentgen appearance alone might prove difficult. If the disease is limited to one kidney, there are frequently few differential points or none at all. Too often the diagnosis is made only at operation or necropsy. Although it is true that a necrotic slough may create a negative shadow within the collecting system, simulating a calculus, this feature should cause little confusion, since careful examination by retrograde study will commonly disclose other structural changes in the calyces. Acute pyelonephritis without necrosis may cause some difficulty in diagnosis, especially in the early phase of the disease. However, the gross filling defects in the pyelograms resulting from necrosis, the moth-eaten appearance of the calyces, and



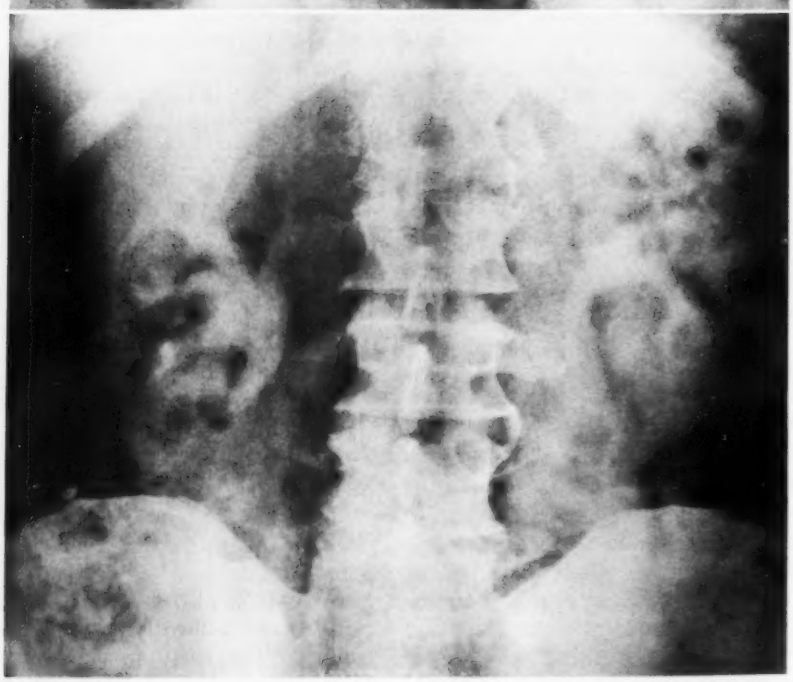


Fig. 4 (above). Retrograde pyelogram showing kink of right ureter which caused obstructive hydronephrosis.

Fig. 5 (below). Intravenous pyelogram made several weeks after retrograde study, showing function of right kidney. The collecting system is otherwise unchanged.

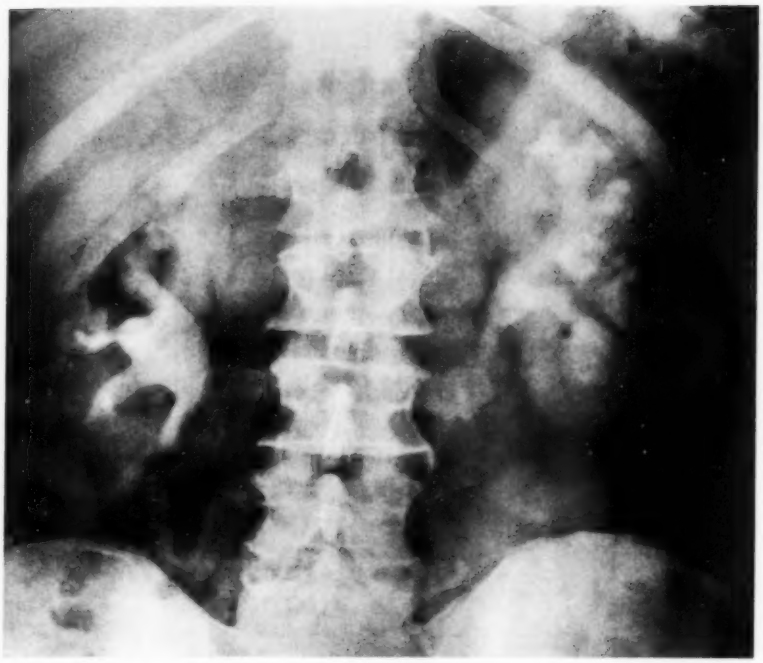


Fig. 6. Interval excretory pyelogram showing blotchy appearance of the calyces and the presence of "ring shadows."

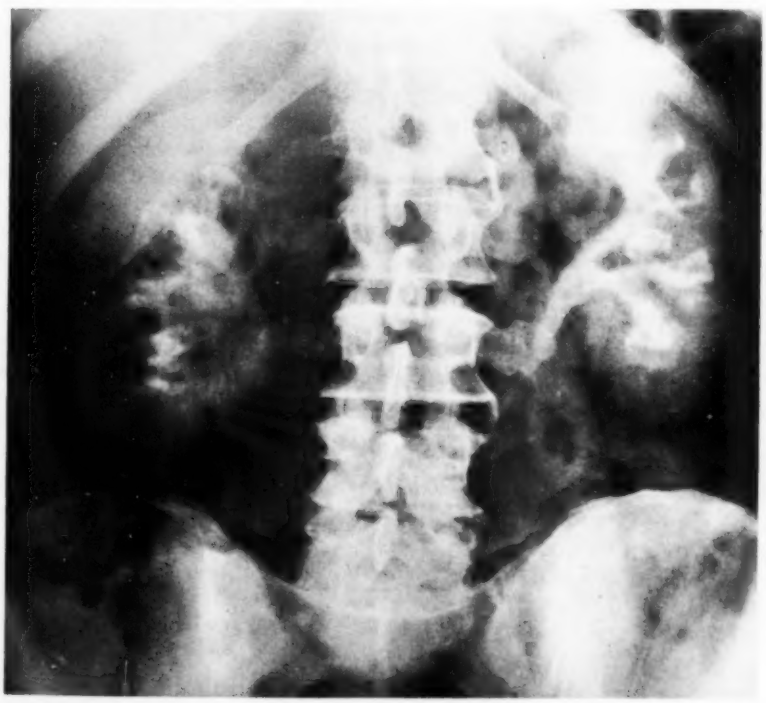


Fig. 7. Lucent halos involving the minor calyces (ring shadows) and multiple filling defects of calyces and pelves.

the occurrence of "ring shadows" about the calyces will suggest the correct diagnosis. Finally, renal papillary necrosis should always be suspected when there is a history of diabetes, lower urinary tract obstruction, and negative smears and cultures for acid-fast bacilli, plus the roentgen features described above.

SUMMARY

A case of renal papillary necrosis has been presented. The pathological and radiological features of the disease are discussed and illustrated.

New York Hospital
525 E. 68th St.
New York 21, N. Y.

REFERENCES

1. VON FRIEDREICH, N.: Über Necrose der Nierenpapillen bei Hydronephrose. Virchows Arch. path. Anat. **69**: 308–312, 1877.
2. MANDEL, E. E.: Renal Medullary Necrosis. Am. J. Med. **13**: 322–327, September 1952.
3. OLSSON, O.: Spontanes Gaspyelogramm. Acta radiol. **20**: 578–584, 1939.
4. ESKELUND, V.: Necrosis of Renal Papillae Following Retrograde Pyelography. Acta radiol. **26**: 548–554, 1945.
5. HARRISON, J. H., AND BAILEY, O. T.: Significance of Necrotizing Pyelonephritis in Diabetes Mellitus. J.A.M.A. **118**: 15–20, Jan. 3, 1942.
6. ROBBINS, S. L., MALLORY, G. K., AND KINNEY, T.: Necrotizing Renal Papillitis: A Form of Acute Pyelonephritis. New England J. Med. **235**: 885–893, Dec. 19, 1946.
7. EDMUNSON, H., MARTIN, H. E., AND EVANS, N. G.: Necrosis of Renal Papillae and Acute Pyelonephritis in Diabetes Mellitus. Arch. Int. Med. **79**: 148–175, February 1947.
8. ROBBINS, E. D., AND ANGRIST, A.: Necrosis of the Renal Papillae. Ann. Int. Med. **31**: 773–793, November 1949.
9. MUIRHEAD, E. E., VANATTA, J., AND GROLLMAN, A.: Papillary Necrosis of the Kidney. Clinical and Experimental Correlation. J.A.M.A. **142**: 627–631, March 4, 1950.
10. SWARTZ, D.: Renal Papillary Necrosis. J. Urol. **71**: 385–397, April 1954.
11. GARRETT, R. A., NORRIS, M. S., AND VELLIOS, F.: Renal Papillary Necrosis. A Clinicopathologic Study. J. Urol. **72**: 609–617, October 1954.
12. ALKEN, C. E.: Die Papillennekrose. Ztschr. f. Urol. **32**: 433–438, 1938.
13. KNUTSEN, A., JENNINGS, E., BRINES, O. A., AND AXELROD, A.: Renal Papillary Necrosis. Am. J. Clin. Path. **22**:327–336, April 1952.
14. GÜNTHER, G. W.: Die Papillennekrosen der Niere bie Diabetes. Munchen med. Wchnschr. **84**: 1695–1699, Oct. 22, 1937.

SUMARIO

Necrosis Papilar Renal

Preséntanse las características radiológicas e histopatológicas de la necrosis papilar renal, con la descripción de un caso observado en un varón no diabético de cincuenta y cinco años de edad. La dolencia, observada habitualmente en los diabéticos, se caracteriza por abscesos esparcidos localizados en las pirámides renales; a medida que la enfermedad avanza, los abscesos confluyen, dando por resultado esfacelo de los dos tercios terminales de la pirámide. El proceso es frecuentemente (pero no siempre) bilateral.

El cuadro radiográfico es consecuencia de la destrucción de las papilas renales y/o del proceso inflamatorio concomitante, dependiendo, pues, el diagnóstico del período de la enfermedad en que se ejecuta el examen. Ofrécese un sumario de los hallazgos para distintas fases, basado en comunicaciones de la literatura y la propia experiencia de los AA. Las características importantes son: la tardanza o falta total de la función; la dilatación leve a moderada del aparato colector; el aspecto moteado, apolillado de los fórnices; nichos macroscópicos; sombras anulares, o sean coronas radiolucientes alrededor de los cálices dilatados; extravasación de la substancia de contraste a la corteza renal.

Evaluation of Routine Skull Films in Intracranial Meningiomas[1]

TED F. LEIGH, M.D., EDGAR F. FINCHER, M.D., AND MAXWELL F. HALL, Jr., M.D.

THE MENINGIOMA is a slow growing, benign tumor of the arachnoid, which occurs with relative frequency in the intracranial cavity. It represents about 12 to 15 per cent of all intracranial tumors (22, 24, 26). It is quite variable in size, and is usually single, though it may be multiple. It occurs for the most part in adults, but occasionally is found in children (16). It may be located extracranially, in such anatomical areas as the orbit and the spinal canal.

Although benign, meningiomas may be malignant in their behavior, compressing and destroying adjacent tissues. The tumor is well encapsulated at its free margins, but at its meningeal attachment may invade the adjacent bone. Often it can be removed in its entirety; occasionally it recurs after incomplete removal.

A few of these tumors develop without meningeal attachment, such as those found in the ventricles and those arising deep in the sylvian fissure. Pendergrass and Hope (21) reported one such example, having its origin in the outer table of the frontal bone, with no apparent intracranial source.

The meningioma is quite variable in its location in the cranial vault; a classification as to origin was proposed by Cushing (3, 4), and was employed by Sosman and Putnam (26) in their discussion. The sites listed are: the cranial nerve foramina; the suprasellar area; the olfactory groove of the ethmoid; the sphenoid ridges; the sylvian cleft area; over the convexities of the brain; the parasaggital area; the falx; the transverse and sigmoid sinuses.

Grossly, the tumor is of one of two forms. The first of these is the globular or spheroidal (rounded, ovoid, or lobulated), usually with a relatively small dural attachment. The second is the *en plaque* or flat type, which spreads along the dura; it is attached over a relatively broad area.

The microscopic picture of the meningioma is variable; nine different types with variants were described by Cushing and Eisenhardt (4). The tumor was first thought to originate in the dura, but in the early days of neurosurgery the concept that it arose from the villi of the pia arachnoid was advanced, and this is the accepted theory today. The villi extend into the dura, so that grossly the tumor seems to arise from the latter.

The term meningioma is of fairly recent origin, having been given to this tumor by Cushing. In an article written by him in 1922 (3), the following statement appears: ". . . and as the term employed, namely dural endothelioma, gives the wrong impression of the membrane from which the growth has originated, the designation meningiothelioma or meningioma is suggested as a compromise. This at least avoids the objection which the embryologist might raise, for strictly speaking the growths would seem to be properly called mesotheliomas of arachnoid origin."

RADIOLOGICAL CONSIDERATIONS

The meningioma is an ideal lesion for study by the roentgen ray, and fully 50 per cent of all routine skull series are positive in its presence (8, 13, 19, 24, 26). This fact has long been recognized. The first articles describing the associated bone changes appeared at the turn of the century. In the intervening years, other articles have been published, by distinguished radiologists and neurosurgeons of both the past and the present.

The meningioma may produce one or more of the following positive findings in the routine skull examination: (1) bony

[1] From the Departments of Radiology and Surgery, Emory University School of Medicine, Atlanta, Ga. Presented as a paper and an exhibit (awarded Certificate of Merit) at the Forty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 11–16, 1955.

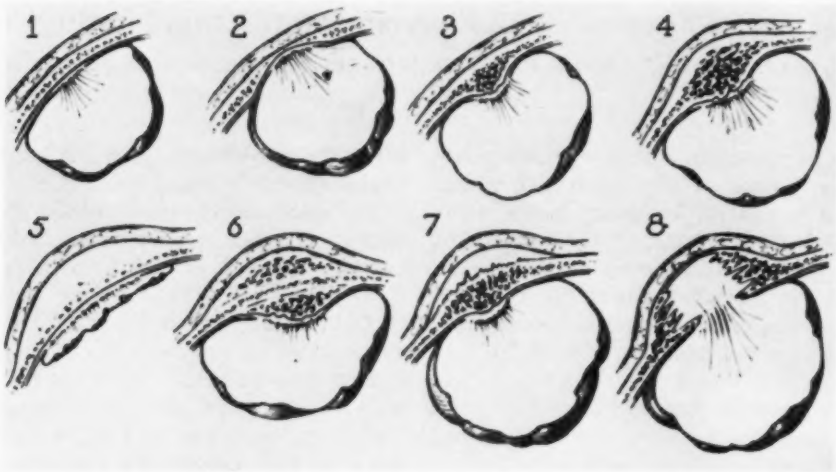


Fig. 1. Types of bone changes caused by the meningioma (from Cushing and Eisenhardt: Meningioma. Springfield, Ill., Charles C Thomas, 1938).
1. No changes in the bone except increased vascularity.
2. Pressure absorption without tumor invasion.
3. Small hyperostosis at the meningeal attachment of the tumor, involving mainly the inner table, and containing tumor cells.
4. Larger hyperostosis, expanding the inner and outer tables, and containing tumor cells.
5. Hyperostosis predominating in dense, eburnated bone.
6. Hyperostosis with heavy infiltration of the haversian canals by the meningioma.
7. Hyperostosis with a superimposed pancake of tumor between the bone and the galea.
8. Hyperostosis with its center destroyed by a heavy infiltration of tumor tissue.

alterations, either productive or destructive, (2) vascular alterations, (3) tumor calcifications, (4) sellar alterations, (5) pineal shift. Of these five classes, three are often characteristic of meningioma, namely, bone production, increased vascularity, and tumor calcification. It is these three which will be discussed in this paper; the latter two are so well known to radiologists that they need not be considered.

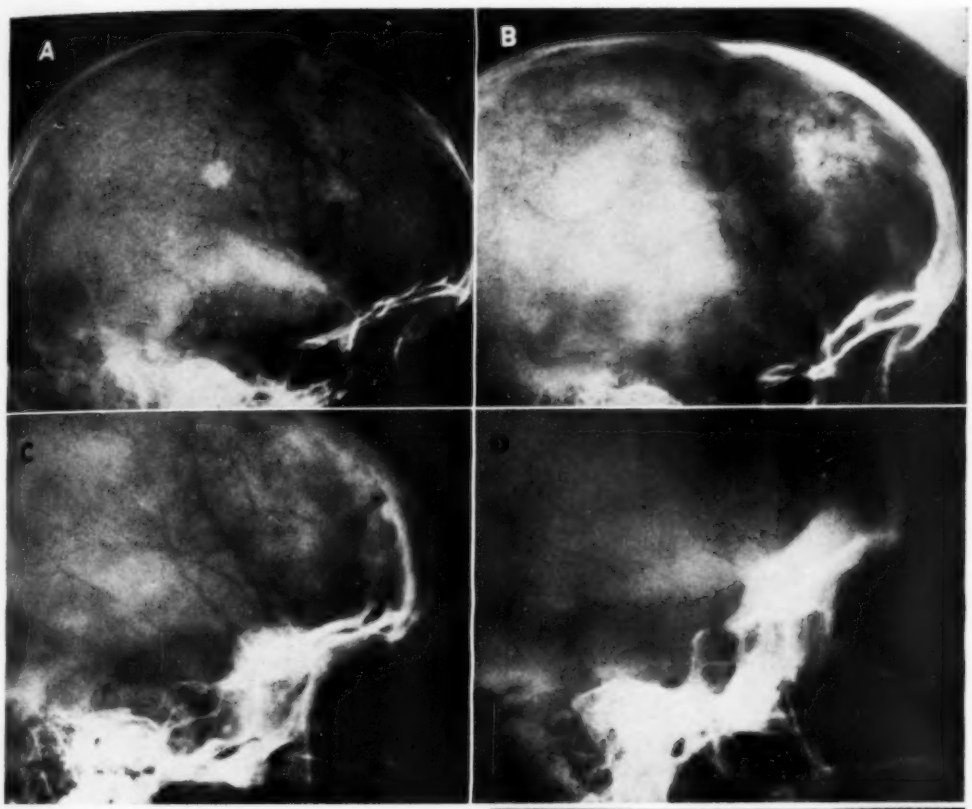
Bony Alterations

The most common types of bone change produced by meningioma have been sketched by Cushing and Eisenhardt, and are shown in Figure 1.

The predominant bony alteration due to the meningioma is the hyperostosis, estimated to occur in 25 per cent of cases (5, 22, 23, 26). The smallest type of hyperostosis is the endostoma (Fig. 2A), a small area of bony thickening projecting inwardly at the site of the tumor's dural attachment; the tumor itself is usually of much larger size. The largest type of hyperostosis is the one which spreads over an extensive area of the vault or base, resulting in great thickening of the bone. A notable example of the latter is the spreading or *en plaque* tumor of the sphenoid ridge (Fig. 2, D and E). Other examples of hyperostosis are shown in Figure 2.

The hyperostosis has two components. The first of these is an infiltration of the tumor cells into the bone which is already present; this occurs into the intertrabecular spaces and the haversian canals. The resultant broadening of these spaces and the concurrent increase in the number of vascular channels give to the bone a spongy texture (Fig. 3A)(5). The second component is new bone, laid down in layers which are parallel to the skull initially but further away become perpendicular. It is these perpendicular layers that account for the "sunburst" appearance so commonly seen in a tangential view (Fig. 3B).

Tumor cells and blood vessels grow into this new bone, the extent of their growth



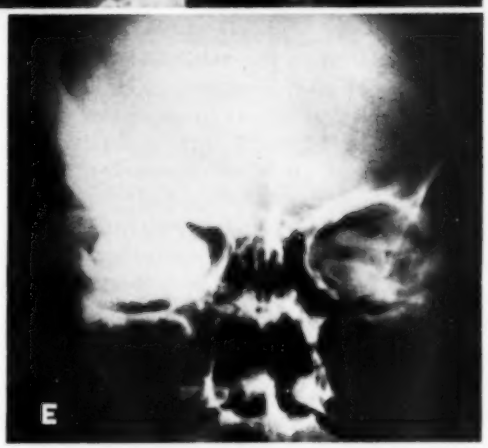


Fig. 2. Examples of hyperostoses produced by meningioma.
A. Small endostoma of the left parietal bone, associated with a larger spheroidal meningioma.
B. Hyperostosis of the frontal bone on its left side; the bone appears spongy in consistency because of invasion by tumor cells and hypervascularity.
C. Marked hyperostosis in the floor of the anterior fossa and in the ethmoid cells, characteristic of the *en plaque* meningioma of the olfactory groove.
D. Hyperostosis of the sphenoid ridge and surrounding skull base, caused by an *en plaque* meningioma of the sphenoid ridge. Lateral view to show extent of involvement.
E. Frontal view of case shown in D.

determining whether or not the bone is spongy. At times no tumor cells can be identified in the hyperostosis (23), and in such instances the new bone is quite eburnated.

When a hyperostosis occurs in one of the bones of the vault, the growth is more extensive on the outer table than on the inner. In such a hyperostosis the outer and inner tables will still be identifiable on cut section, although ill defined (see Fig. 3A).

When a meningioma is removed and the hyperostotic bone left in place, tumor proliferation within the bone and growth of new bone apparently cease.

When the hyperostosis is small, it may be entirely overlooked on routine films.

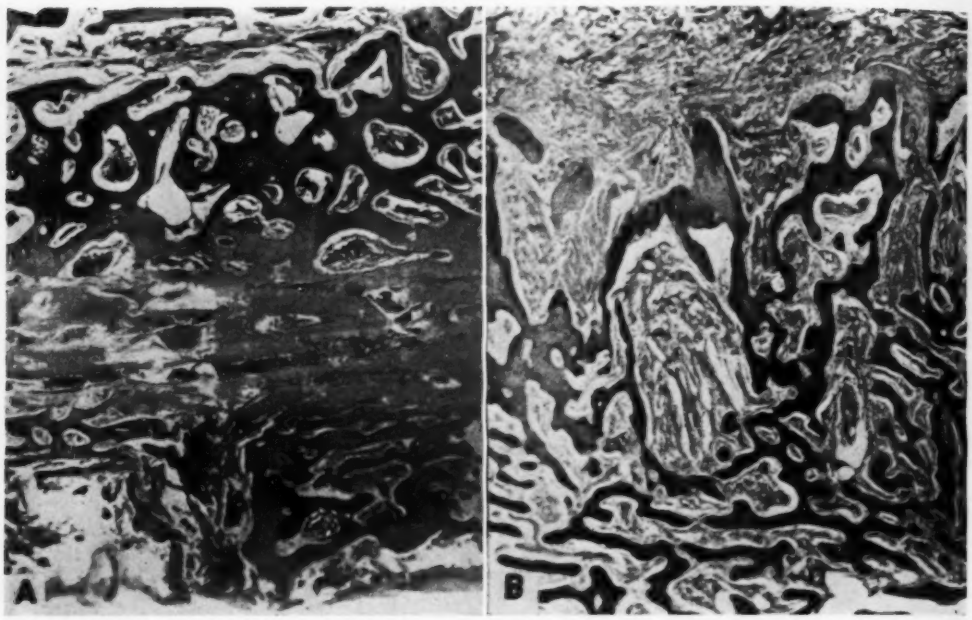


Fig. 3. Photomicrographs of a hyperostosis (courtesy of Dr. Francis Echlin).
A. Invasion of the inner table and diploe by tumor tissue and new blood vessels.
B. New bone near the outer table is laid down parallel to the table, but more peripherally the layers are perpendicular, producing the "sunburst" appearance commonly seen on the tangential film.

Especially is this true when it resembles ridges in normal bone or plaques of calcium in the falx cerebri, and when it is obscurely placed in the skull base or at the vertex of the cranial vault. Good roentgen technic and careful examination are prime requisites in the study of these small areas.

In contrast to hyperostosis formation, the meningioma may also produce destruction of bone (Fig. 4); frequently this process is the result of pressure rather than of invasion (4, 22, 24). Bone destruction is of four different degrees, depending on the advancement of the process. These are: (*a*) pressure thinning of the inner table, (*b*) erosion of the inner table, (*c*) destruction of the inner table and erosion of the outer table, (*d*) destruction of the inner and the outer tables (see Fig. 1).

At times the destruction may occur within an area of hyperostosis, giving to the bone a bizarre appearance of destruction and production in the same area (Fig. 1). Cushing (3) states that the central portion of a hyperostosis may, through subsequent absorption, become occupied by tumor cells to the exclusion of anything more than occasional bony spicules.

A small area of thinning or rarefaction, like a small hyperostosis, may be easily overlooked or misinterpreted on routine skull roentgenograms.

Vascular Alterations

The meningioma is a highly vascular tumor and as such is capable of causing changes in the vascular channels of the skull (Fig. 5). These changes are of several different types.

1. *Vascular Changes Localized to the Site of the Tumor:* Lindblom (15) has described two patterns. The first of these is a network of fairly wide vascular channels, often in stellate form, from which one or more large channels extend to a dural sinus (Figs. 2B and 5B). The second pattern is a fine honeycombing of the inner table of the skull, apparently resulting

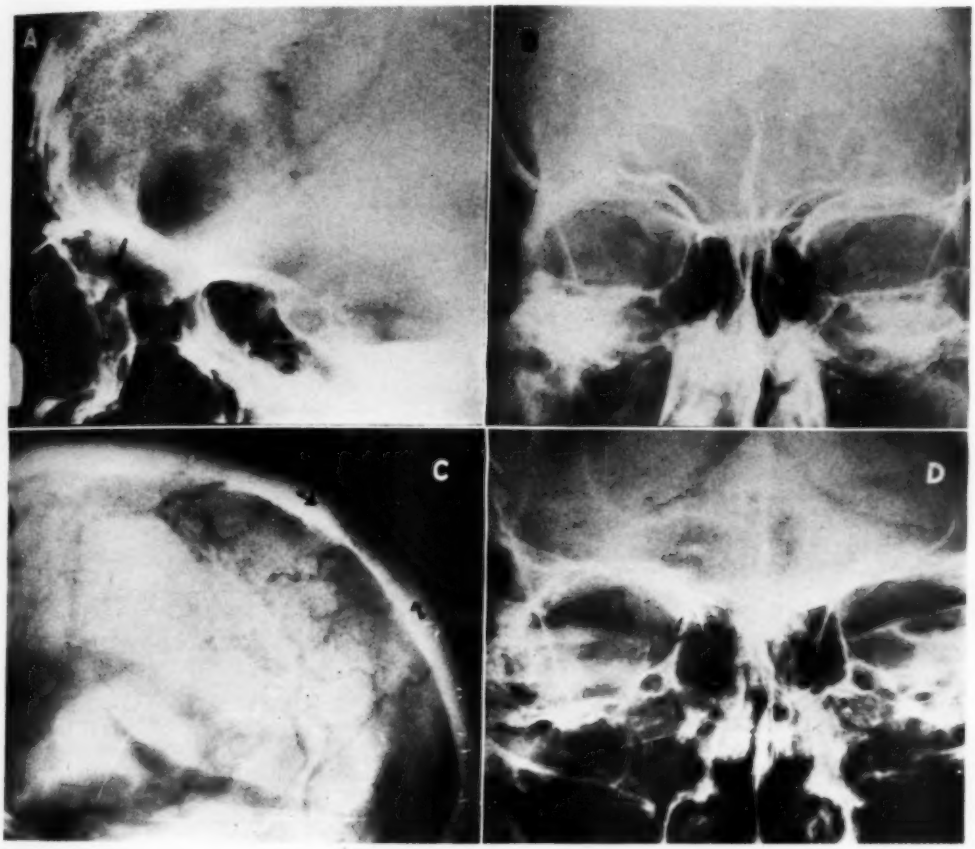


Fig. 4 Examples of bone destruction produced by the meningioma.
A. Pressure thinning and depression of the cribriform plate area by a spheroidal meningioma arising from the floor of the anterior fossa.
B. Demineralization of the left sphenoid wing caused by a spheroidal meningioma attached to this wing.
C. Destruction by a parasagittal meningioma in the parietal region. Although it is not depicted in this lateral view, there was a hole completely through the outer and inner table of the vault.
D. Partial destruction of apex of right petrous pyramid, resulting from a meningioma spreading along the skull base. The tumor involved several cranial nerves and the right half of the sella turcica, as well as the pyramid.

from many small vessels passing through the skull, seen end-on.

2. *Enlargement of the Vascular Channels of the Skull Supplying the Tumor:* A meningioma may derive its blood supply wholly or in part from those vessels which normally groove the inner table of the cranial bones. The result of this may be a unilateral enlargement of existing vessels. Involvement of the middle branch of the meningeal artery is most common, but other arteries and veins may be enlarged as well (Figs. 5, A and B).

Along with unilateral enlargement of the middle meningeal artery, there may occur also an enlargement of the foramen spinosum through which this artery enters the cranial cavity at its base. Enlargement of the foramen spinosum and the groove of the meningeal artery in the base, without enlargement of the groove at higher levels in the vault, is suggestive of a tumor attached to or around the sphenoid wing in its lateral aspect (6). It has been pointed out by many authors, and is emphasized in this paper, that unilateral enlargement

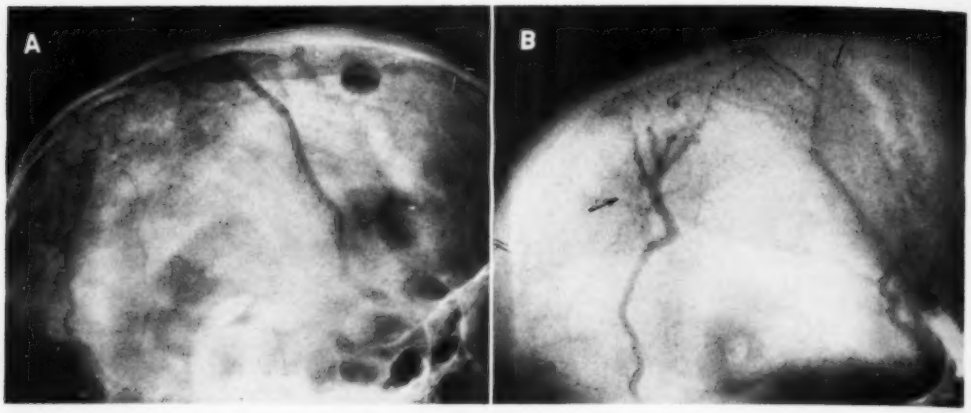


Fig. 5. Examples of vascular alterations produced by the meningioma.
A. Unilateral enlargement of the left middle meningeal artery by a parasagittal meningioma.
B. Unilateral enlargement of a posterior temporal diploic vein and of the middle meningeal artery. There are many small vessels localized to the site of the tumor in the parasagittal area.

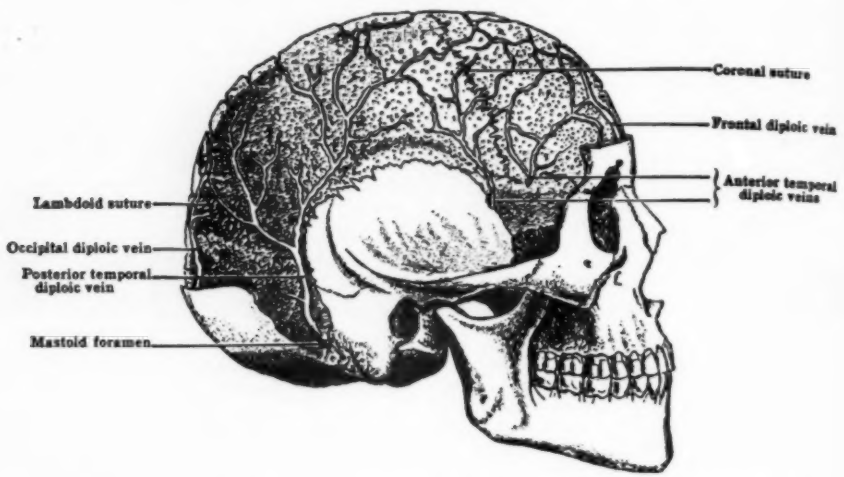


Fig. 6. The veins of the diploe (from Morris' Human Anatomy). Four groups are shown: frontal, anterior temporal, posterior temporal, and occipital.

of vascular channels and foramen may occur as a normal variant, so that this finding is not sufficient for establishment of a diagnosis of a space-occupying lesion unless supported by appropriate clinical findings.

3. *Unilateral Enlargement of One of the Diploic Veins:* According to most authors (6, 18), there are four diploic veins: the frontal, anterior temporal, posterior temporal, and the occipital (Fig. 6). These veins lie in the cancellous tissue between the inner and outer tables of the skull, and their channels are often visible on routine films. Elsberg and Schwartz (6) expressed the opinion that, if the diagnosis of brain tumor has been made and unilateral enlarged diploic channels are found in the general area where the tumor is suspected, then there is considerable probability that the new growth is a meningioma; they had not seen this feature in other types of tumor.

The increase in size and number of the

diploic veins is the direct result of compression of the cerebral veins, the interference with the venous circulation within the cranial chamber, and the collateral enlargement of the veins of the diploe.

4. *Enlargement of the Occipital Emissary Vein:* The occipital emissary vein runs vertically near the mid-line in the occipital bone. It enters the cranium through a foramen below the occipital protuberance, and may make its exit through a foramen at a higher or lower level in the occipital bone by way of diploic channels connecting the two foramina. Lindblom (15) states that normally these foramina do not exceed 2.0 mm. in width, but in the presence of increased intracranial pressure there occurs visible enlargement of this system (Fig. 7). This enlargement is said to be more probably due to obstruction to drainage of the periosteal and osseous venous blood toward the lateral sinus, by compression of the inner veins running obliquely through the dura, than to an increased drainage from the sinus or the vessels of the dura outward.

5. *Decrease in the Vascular Markings:* Lindblom also described a decrease in the vascular markings of the calvarium occurring in the presence of slowly growing intracranial tumors in the cerebral hemispheres, and in chronic hydrocephalus. He states that this is a local phenomenon, often associated with pressure atrophy of the inner table diploe. Venous channels tend to disappear more quickly than the arterial, probably because of the difference of pressures in these blood vessels.

Tumor Calcification

Meningiomas at times contain calcium (Fig. 8). In Camp's series (2), 18 percent produced roentgen evidence of calcification. He further states that the calcific deposits "have a characteristic roentgenographic appearance which is imitated only by those occurring in the ependymomas." The calcium is within the psammoma bodies of the tumor, and produces a typical punctate appearance on the roentgenogram. The deposits may be widely scattered or so compact that they seem to be nearly homogeneous.

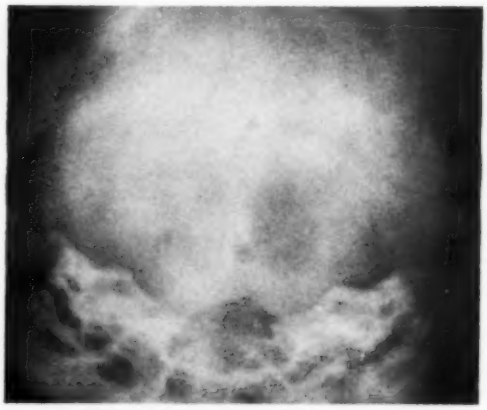


Fig. 7. Enlargement of the occipital emissary vein and its foramen. This may occur in the presence of increased intracranial pressure from any cause and is not specific for meningioma.

Monckton (17), in his series of cases, noted three different configurations of the calcium deposits—flocculent, linear, and wheel-like. The linear deposits were considered to be within the tumor capsule.

The meningioma has also been known, on occasion, to contain bone or cartilage (4). These tissues are within the tumor, not attached to the dura or to the skull. Although small, they might conceivably be visible radiographically if sufficient calcium were contained within them.

SUMMARY

The meningioma in its growth commonly causes abnormalities that are readily visible on the routine skull examination.

These changes may be classified as follows: bony alterations, vascular alterations, sellar destruction, tumor calcifications, and pineal shift. Three of these, namely, bone changes, vascular changes, and tumor calcifications, are often characteristic of the meningioma.

Emory University Hospital
Emory University, Georgia

REFERENCES

1. CAMP, J. D.: Roentgenologic Observations Concerning Erosion of the Sella Turcica. Radiology **53**: 666–674, November 1949.

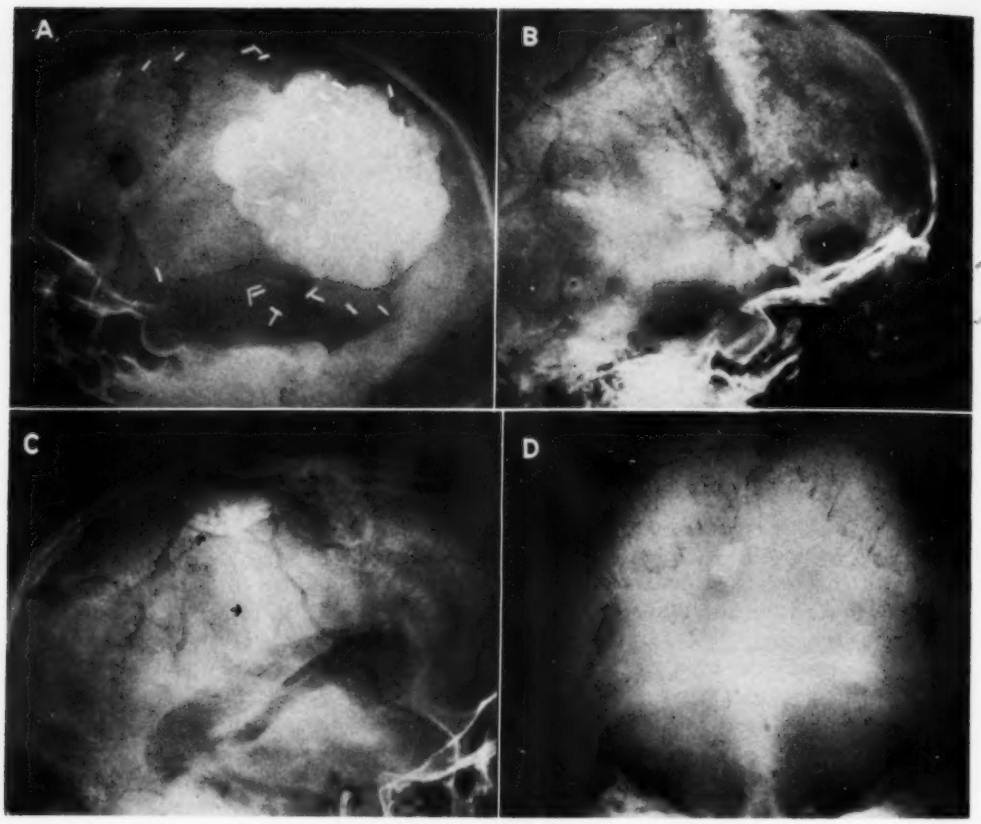


Fig. 8. Examples of calcifications occurring within meningiomas.
A. Amorphous calcium deposits in a recurrent meningioma.
B. Faint calcium deposits outlining a spheroidal meningioma of the olfactory groove.
C. Dense deposits in portions of a large parasagittal meningioma.
D. A small amorphous calcium deposit in a large parasagittal meningioma.

2. CAMP, J. D.: Significance of Intracranial Calcification in the Roentgenologic Diagnosis of Intracranial Neoplasms. Radiology **55:** 659–668, November 1950.

3. CUSHING, H.: The Cranial Hyperostoses Produced by Meningeal Endotheliomas. Arch. Neurol. & Psychiat. **8:** 139–154, August 1922.

4. CUSHING, H., AND EISENHARDT, L.: Meningiomas. Their Classification, Regional Behavior, Life History, and Surgical End Result. Springfield, Charles C Thomas, 1938.

5. ECHLIN, F.: Cranial Osteomas and Hyperostoses Produced by Meningeal Fibroblastomas. Arch. Surg. **28:** 357–405, February 1934.

6. ELSBERG, C. A., AND SCHWARTZ, C. W.: Increased Vascularity in Its Relation to Intracranial Disease. Arch. Neurol. & Psychiat. **11:** 292–307, March 1924.

7. FINCHER, E. F.: Experiences with Meningiomas. S. Clin. North America **34:** 1037–1049, August 1954.

8. GRANT, F. C.: A Clinical Experience with Meningiomas of the Brain. J. Neurosurg. **11:** 479–487, September 1954.

9. GRUNOW, O. H.: Radiating Spicules, a Non-Specific Sign of Bone Disease. Radiology **65:** 200–205, August 1955.

10. KARSNER, H. T.: Human Pathology. Philadelphia, J. B. Lippencott Co., 6th ed., 1942.

11. HEUER, G. J., AND DANDY, W. E.: Roentgenography in the Localization of Brain Tumors, Based Upon a Series of 100 Consecutive Cases. Bull. Johns Hopkins Hosp. **27:** 311–322, November 1916.

12. HODES, P. J., PENDERGRASS, E. P., AND DENNIS, J. M.: Cerebellopontine Angle Tumors: Their Roentgenologic Manifestations. Radiology **57:** 395–406, September 1951.

13. HORRAX, G., AND STRAIN, R. E.: Subjective and Objective Criteria in the Diagnosis of Meningiomas of the Brain, with Remarks as to the Mortality and Useful Survival. Ann. Surg. **135:** 892–898, June 1952.

14. HOWARTH, J. C., AND BUNTS, A. T.: Intracranial Meningoma Following Trauma. Report of a Case. Cleveland Clin. Quart. **17:** 14–18, January 1950.

15. LINDBLOM, K.: A Roentgenographic Study of the Vascular Channels of the Skull with Special Reference to Intracranial Tumors and Arteriovenous Aneurysms. Acta. radiol. Suppl. 30, 1936.

16. MADOW, L., AND FARMER, R. A.: Osteoblastic Meningioma in a Child. Arch. Neurol. & Psychiat. **63:** 596–605, April 1950.
17. MONCKTON, G.: An Investigation into the Causes of Failure of Certain Supratentorial Meningiomata to Show Tumour Vessels on Angiography. Brain **76:** 149–183, June 1953.
18. Morris' Human Anatomy. Philadelphia, The Blakiston Co., 10th ed. 1942.
19. OLIVECRONA, H.: The Parasagittal Meningiomas. J. Neurosurg. **4:** 327–341, July 1947.
20. PENFIELD, W. G.: Cranial and Intracranial Endotheliomata-Hemicraniosis. Surg., Gynec. & Obst. **36:** 657–674, May 1923.
21. PENDERGRASS, E. P., AND HOPE, J. W.: An Extracranial Meningioma with No Apparent Intracranial Source. Report of a Case. Am. J. Roentgenol. **70:** 967–970, December 1953.
22. PENDERGRASS, E. P., AND PERRYMAN, C. R.: Röntgenologic Aspects of Meningiomas. Brit. J. Radiol. **25:** 225–234, May 1952.
23. ROWBOTHAM, G. F.: The Hyperostoses in Relation with the Meningiomas. Brit. J. Surg. **26:** 593–623, January 1939.
24. SCHWARTZ, C. W.: The Meningiomas from a Roentgenological Viewpoint. Am. J. Roentgenol. **39:** 698–712, May 1938.
25. SOSMAN, M. C.: The Reliability of the Roentgenographic Signs of Intracranial Tumor. Am. J. Roentgenol. **36:** 737–743, December 1936.
26. SOSMAN, M. C., AND PUTNAM, T. J.: Roentgenologic Aspects of Brain Tumors: Meningiomas. Am. J. Roentgenol. **13:** 1–10, January 1925.
27. TEPLICK, J. G., AND DORSEY, P.: The Roentgen Findings in Intracranial Mass Lesions. Am. J. Roentgenol. **61:** 762–774, June 1949.
28. WEYAND, R. D., AND CAMP, J. D.: Roentgenographic Examination in Meningioma of the Tuberculum Sellae or Olfactory Groove. Am. J. Roentgenol. **71:** 947–951, June 1954.
29. WINDHOLZ, F.: Cranial Manifestations of Fibrous Dysplasia of Bone. Their Relation to Leontiasis Ossea and to Simple Bone Cysts of the Vault. Am. J. Roentgenol. **58:** 51–63, July 1947.

SUMARIO

Justipreciación de las Radiografías Corrientes del Cráneo en los Meningiomas Intracraneales

Los meningiomas son tumores ideales para el examen roentgenológico dado que a lo menos 50 por ciento de todas las series craneales corrientes son positivas cuando existen. Esas neoplasias pueden producir uno o más de los siguientes hallazgos en las radiografías corrientes: alteraciones óseas, modificaciones vasculares, calcificaciones, alteraciones de la silla turca y desviación pineal. No se consideran aquí más que los tres primeros.

Las alteraciones óseas pueden ser ya proliferantes o destructoras. La característica predominante es hiperostosis, que se calcula existe en 25 por ciento de los casos. La osteólisis puede tomar la forma de adelgazamiento por compresión o de erosión que afectan la tabla interna del cráneo o ambas tablas interna y externa.

Las alteraciones vasculares pueden limitarse al sitio del tumor o quizás afecten los conductos vasculares de los que procede el riego sanguíneo del último. Puede haber hipertrofia unilateral de una de las venas diploicas, hipertrofia de la vena emisaria occipital o atenuación de las marcas vasculares.

La calcificación del tumor toma aspecto punteado con depósitos sumamente esparcidos o muy compactos.

The Value of Radiation Therapy in the Management of Glioma of the Optic Nerves and Chiasm[1]

JUAN M. TAVERAS, M.D., and LESTER A. MOUNT, M.D.
New York, N. Y.
and
ERNEST H. WOOD, M.D.
Chapel Hill, N. C.

THE MOST COMMON primary tumors of the optic nerves and chiasm are those which arise from the glial stroma of the visual pathways. Growth of the neoplasms is slow but the natural course is an extension of the process with the production of blindness and often death. Since optic nerve gliomas are encountered infrequently, the effect of various forms of treatment is difficult to assess. It is the purpose of this paper to report, in summary, the case histories of 34 patients with primary glioma of the optic nerves and chiasm and to evaluate the use of radiation therapy and surgery in their management.

INCIDENCE AND PATHOLOGY

Optic nerve gliomas are tumors of young people. They are not, however, closely related to the highly malignant retinoblastoma, which also is a disease of early life. Optic gliomas are relatively uncommon, constituting only 1 to 2 per cent of all glial new growths (Martin and Cushing, 11; Lundberg, 10). The 34 cases to be reported here occurred during a period when approximately 2,000 surgically verified gliomas of all types were encountered in the Neurological Institute of New York. The incidence in the two sexes is essentially equal.

Optic gliomas produce an expansion of the nerve or chiasm which may consist of a solitary fusiform enlargement or may form a solid irregular thickening along the entire course of the nerve. Localized enlargements often attain a diameter of 2.5 cm., and in some instances may be larger. The nerve sheath usually is not penetrated, although extraneural extension may sometimes occur in the late stages of growth.

Tumors which arise within the orbital cavity may extend intracranially and *vice versa*. Extension results in erosion of the optic canal by pressure, and usually the canal becomes enlarged (Fig. 1), which is an important finding for roentgen diagnosis (Pfeiffer, 13). Radiologic evidence of such enlargement should be taken to indicate involvement of the intracranial portion of the nerve. Patients, when first seen, can for the most part be placed in one of three groups, depending on the gross pathological extent of the tumor. In some instances involvement is limited to one optic nerve throughout the course of the disease, because tumor growth may be self-limited. In other cases one optic nerve and the optic chiasm may be involved. The majority of our cases fall into this latter category. Examples of widespread intracranial extension of tumor may also be seen, even with ventricular obstruction and internal hydrocephalus.

On section, the nerves and chiasm usually are found to be diffusely thickened. In some instances there may be a solid tumor nodule displacing the nerve eccentrically and compressing it into a crescentic form. Cystic degeneration may occur in the neoplastic tissue. The tumors ordinarily are not excessively vascular but in an occasional instance blood vessels are present in great numbers (Hudson, 9).

A complete histologic description and a clear differentiation between gliomas and nerve sheath tumors was given by Verhoeff (16, 17). Disagreement still exists, however, among pathologists regarding the nature of the glial cells of which the tumor is composed. Some authors believe

[1] From the Departments of Radiology and Neurological Surgery of the College of Physicians and Surgeons, Columbia University, and the Radiological and Surgical Services of the Neurological Institute, New York, N. Y. Presented at the Forty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 11-16, 1955.

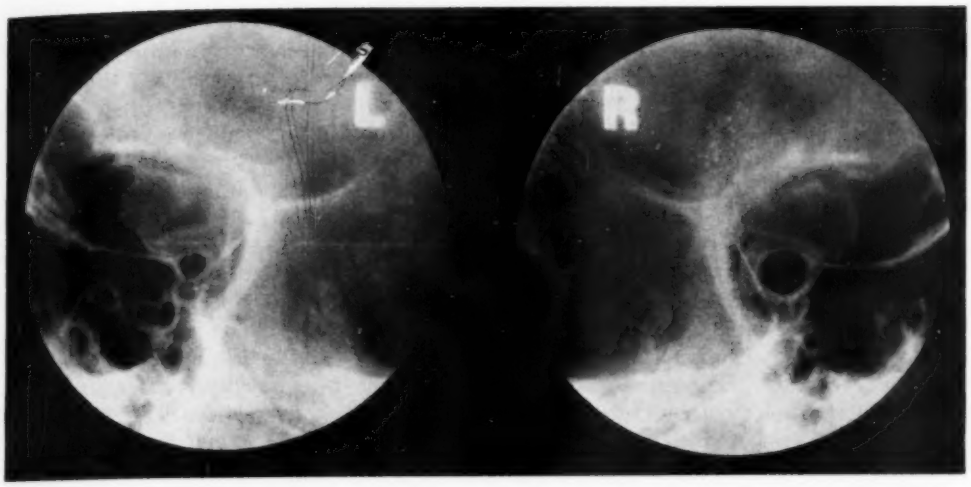


Fig. 1. Films of the optic canals in the MacMillan projection reveal a marked asymmetry of the two sides The normal left canal measures 6 mm. in diameter while the right is twice as large. Enlargement of one optic canal occurs in the majority of patients with optic nerve glioma and is indicative of both intracranial and intraorbital growth of the tumor.

them to be unipolar and bipolar spongioblasts (Grinker, 7; Cuneo and Rand, 3). Others consider them to be predominantly piloid astrocytes, the elongated form resulting from a mechanical effect upon the cells as they grow in and among tight nerve bundles (Martin and Cushing; Wolf and Cowen, 19). The tumor cells spread and compress the fibers of the optic nerves, which become demyelinized early in the growth process, with production of a primary optic atrophy. When the nerve is compressed peripherally, normal appearing axis cylinders may remain.

The opinion that optic nerve glioma is a manifestation of von Recklinghausen's disease is popular (Emanuel, 6, Davis, 4), though some, notably Martin and Cushing, have pointed out that of all the cranial nerves the optic are least often involved in neurofibromatosis. In addition, the optic tumors are rich in glial fibers, which are absent in neurinomas. Von Hippel (8) believed that in the gliomas there is an inherent growth tendency in both glial and mesodermal tissues. In 3 of the series reported here there were findings compatible with von Recklinghausen's disease. The mother of a fourth patient had neurofibromatosis.

PRIOR INVESTIGATION

Discussion of the treatment of gliomas of the optic nerves and chiasm is found infrequently in the radiologic, neurologic, and ophthalmologic literature. The majority of reports are based upon the study of isolated cases or small groups of patients. In the past the value of surgical treatment has been stressed, although its limitations are well recognized (Cuneo and Rand). Some authors are of the opinion that if the lesion can be diagnosed by clinical examination operation should be avoided altogether (Martin and Cushing). Radical surgery usually results in an increase in the visual deficit caused by the tumor, and the surgical destruction of optic pathways is permanent.

The importance of roentgen therapy as a means of controlling the growth of optic gliomas in certain cases has been appreciated by some writers (Grinker; Dyke and Davidoff, 5). Dyke and Davidoff studied 4 patients and concluded that their lesions were favorable for control by radiation methods. All 4 showed improvement, and in 3 the recovery was of a remarkable degree and of long duration. Since no operative removal of the tumor was attempted in any instance, the improvement

was attributed to the radiation effect. The value of radiation to control recurrent growth following surgery is suggested by Parsons (12). While it may be difficult to ascribe relative values to surgery and irradiation in the management of individual cases, experiences with tumor recurrence strongly point to the effectiveness of irradiation alone.

MATERIAL

The material available for analysis comprises 34 cases of glioma of the optic nerves or chiasm. Nineteen of the patients had pathologically verified tumors, all of which were classified as piloid astrocytoma. In 6 patients the diagnosis was established only by surgical gross inspection of the lesion, without removal of tissue; in 9 the diagnosis was made by clinical and radiologic methods without the benefit of surgical and pathologic verification.

The average age of the patients, when first seen, was thirteen years. There were 15 males and 19 females. Twenty-six were under fifteen years of age. The median age for boys was seven years, for girls nine years.

Progressive visual impairment was a clinical feature of all cases. In many instances visual field deficits were found when visual acuity was normal. Primary optic atrophy was frequently observed, as was papilledema. Exophthalmos was present in 13 of the 34 patients. Changes in ophthalmological findings, particularly in the visual fields, provided an excellent means of evaluating the results of treatment.

The most constant radiological finding was enlargement of one optic foramen, which occurred in 24 patients (Fig. 1). In 2 instances both optic foramina were enlarged. In 5 patients examination revealed no foraminal enlargement, and in these cases the tumor was confined either to the orbital chamber or the intracranial cavity. In the remaining 3 cases films of the foramina were not obtained. While this feature is most helpful in the diagnosis of optic nerve glioma, it is not pathognomonic of such a process. Pfeiffer (14) observed enlarged optic foramina in 6 patients with von Recklinghausen's disease who did not have optic tumors. Deformity of the sella turcica in the region of the tuberculum and anterior clinoids, as described by Martin and Cushing, was found in 9 patients.

Pneumography was performed in 21 cases because of suspected intracranial involvement. In every instance suprasellar masses of varying size were found. Repetition of pneumography after radiation therapy provided evidence of remarkable shrinkage of the tumor in numerous instances. Angiography also was found to be useful for the demonstration of the suprasellar tumors and was invaluable in one instance in which a vascular lesion was suspected on clinical grounds.

No cases are included in the unverified group in which the diagnosis is not reasonably well established by clinical and radiologic methods of study. All of the 9 patients had neurologic and ophthalmologic evidence of a primary tumor of the visual pathways. In each instance visual field examination was indicative of a lesion involving one optic nerve and/or the optic chiasm, and in each there was radiologic evidence of enlargement of one optic foramen. In 6 patients there was pressure erosion of the anterior portion of the sella turcica.

Four cases are included which were reported by Dyke and Davidoff in 1942. Two of the patients were found to be living and well in 1954, one twenty-one years following admission and the other nineteen years after institution of treatment. One patient died of intercurrent disease thirteen years after successful treatment of the optic glioma; the other died at home, probably as a result of progressive growth of the lesion intracranially, in spite of adequate radiation therapy.

METHODS AND RESULTS OF TREATMENT

Both surgery and roentgen therapy were used in this group of 34 patients. In the

majority of instances surgery was limited to verification of the lesion by gross inspection, with or without biopsy. In 2 cases, the operation revealed that the tumor did not reach the optic chiasm and consequently the optic nerve was divided proximal to the tumor (Cases 2 and 13). Subsequently prophylactic irradiation was given. Vision in the uninvolved eye in these cases has remained normal for twelve and fourteen years, respectively. In 4 other patients the tumor was removed through an intra-orbital approach and no radiotherapy was employed.

Three of the tumors were of such size that an obstruction was present at the foramen of Monro when the patient was first seen. In 2 of the hydrocephalic patients a Torkildsen procedure was carried out, and in a third a ventriculo-ureteral anastomosis was performed. Death occurred in all 3 cases with ventricular obstruction within two to five months following surgery. The patients who died are listed as radiation failures, but it is of interest that in one of them (Case 9) a second ventriculogram following roentgen therapy and shortly before death showed reduction of the tumor to one-third of its original size, with relief of the obstruction at the foramen of Monro.

The technic of radiation therapy was consistent, although the quantity of radiation delivered and the time of delivery were variable. The patients treated before 1950, which actually comprise all of those available for assessment on a five-year survival basis, received three courses of radiation. The dose delivered to the tumor in each treatment series averaged 1,200 r. The elapsed time of treatment varied, but ranged from eight to twenty-one days. The second series was usually given six weeks after the first, and the second and third series were separated by a similar interval. Further irradiation, as a rule, was not given unless it was thought that maximum regression had not taken place or there was recurrence of symptoms or signs.

The quality of the radiation varied between 0.95 mm. Cu and 1.2 mm. Cu half-value layer. The target-skin distance was 50 cm. for all treatments. Field sizes ranged from 26 to 64 sq. cm. In almost all instances, opposing portals were directed laterally to the posterior portion of the orbital cavity and the region of the sella turcica. Occasional anterior and superior fields were used to increase the dosage delivered to the chiasmal area. In the majority of instances the quantity of radiation delivered at each sitting was 200 r measured in air, and treatments were given daily. In Tables I, II, and III, the quantities of radiation are listed more precisely, in terms of tumor dose. The number of treatment series and the time intervals are also tabulated. It should be noted that in recent years most patients have received a single protracted series of x-ray treatments. At the present time the basic minimum dose for adults is considered to be 4,000 r to the tumor given in twenty-eight days. Following Richmond's formula (15), the dose is reduced for young children (at one year of age 50 per cent of the adult dose; at two years 60 per cent, and at five years 75 per cent). At eight years of age and over, the full adult dose is given.

If all known living patients in whom the diagnosis of optic glioma was made during the last five years are excluded, 22 remain eligible for assessment. Three of the 7 deceased patients died in the immediate postoperative period, having received no radiation therapy. Fifteen of the 19 remaining patients survived more than five years after irradiation was begun. Restoration of lost vision or arrest of the advancing visual deficit occurred following treatment and persisted five years in 8 patients (one-half of the group). The results in these patients have been listed as good. In the other living patients who have been followed more than five years there has been a slow advancement of visual impairment in spite of treatment, but there is no evidence of extension of tumor beyond the optic nerve and chiasm, and the general health has remained good.

TABLE I: RESULTS OF TREATMENT OF OPTIC NERVE GLIOMAS: PATHOLOGICALLY CLASSIFIED (NINETEEN CASES)*

Case No., Age, and Sex	Location of Tumor	Treatment	Exophthalmos	Visual Acuity: On Admission	Visual Acuity: In 1954	Survival in Years	Remarks
1 14 M	Rt. nerve and chiasm	900 r in 10 days (×3 in 0.7 yr.)	Yes	R. 20/20 L. 20/20	R. Blind L. 20/20	15 Alive in 1955	Size of optic foramen increased from 10 to 12 mm. in 10 years, at which time increasing proptosis required intraorbital removal of tumor. Result good.
2 14 F	Left nerve	800 r in 8 days (×3 in 0.5 yr.)	Yes	R. 20/20 L. Hand movements	R. 20/20 L. Blind	14 Alive in 1955	Exophthalmos improved with radiotherapy but did not disappear. Has not increased. Result good.
3 6 M	Rt. nerve and chiasm	1,000 r in 21 days (×5 in 1.3 yr.)	No	R. 20/30 L. 20/40	R. 20/15 L. 20/20	8 Alive in 1955	See text. Result good.
4 14 F	Left nerve and chiasm	1,000 r in 16 days (×6 in 6 yr.)	No	R. 20/20 but complete hemianopsia L. Blind	R. 20/20, 20 per cent field cut (1947) L. Blind	11 Alive in 1955	Last visual field in 1947; acuity normal in 1955. Result good.
5 34 F	Both nerves, chiasm and thalamus	1,200 r in 15 days (×4 in 1.2 yr.)	No	R. 3/200 L. 10/200	No improvement	3.9 Died	Hemiparesis on admission, which improved after radiation. Death in convulsions. Result poor.
6 6 F	Chiasm	Partial removal; 3,500 r in 47 days; 1,800 r in 24 days, after 1 year	No	R. 20/100 L. 20/100 Reduced field and complete hemianopsia	R. 20/20 L. 20/70 One-third field cut only	2 Alive in 1955	Continuous horizontal, vertical, and rotatory nystagmus disappeared following treatment. Result good.
7 4 M	Both nerves, chiasm and hypothalamus	700 r in 14 days (Did not return)	No	Light perception both eyes		?	Lost to follow-up.
8 15 M	Rt. nerve, chiasm, 3rd ventricle, thalamus	2,000 r in 18 days (1 series)	No	R. Count fingers L. Count fingers	R. Count fingers L. 20/200	0.5 Died	Marked ventricular dilatation. Third ventricle obstructed. Result poor.
9 7 M	Chiasm and rt. nerve	Torkildsen op.; 2,800 r in 40 days (1 series)	Yes	R. and L. Count fingers	....	0.3 Died	Second ventriculogram after irradiation showed over 50 per cent shrinkage of tumor and open pathways. Death from meningitis after Torkildsen procedure. Result poor.
10 16 F	Rt. nerve, chiasm, hypothalmus, 3rd ventricle	Torkildsen op.; 1,200 r in 18 days (1 series)	No	R. 20/100 L. 20/50 Homonymous hemianopsia	....	0.3 Died	Third ventricle completely filled with tumor. Result poor.
11 11 M	Both nerves, chiasm and hypothalamus	Biopsy only, no radiotherapy	Bilat.	R. Light perception L. Blind	....	0 Died	First symptom 4 months before admission. Patient semicomatose before operation. Result poor.
12 7 M	Chiasm	Partial removal of tumor. No radiotherapy	No	R. Count fingers L. Blind	....	0 Died	Result poor. Encephalomalacia of hypothalamus, at autopsy.
13 13 F	Rt. nerve	Enucleation and intraorbital removal; 1,400 r in 40 days (×3 in 1 yr.)	Yes	R. 5/200 L. 20/20	R. No vision L. 20/20	12 Alive in 1955	Exophthalmos did not recede after radiation therapy and enucleation and removal of tumor was done later. Result good.

In these instances, treatment has apparently produced only a retardation of tumor growth, rather than its arrest, and the results are listed as fair. One patient successfully treated by surgery and radiation therapy died thirteen years later of unrelated causes and is included among the good results.

Nine patients treated have been followed less than five years. Two of this number have died. The 7 living patients are excluded from assessment. Nevertheless, it

TABLE I—(*Cont.*)

Case No., Age, and Sex	Location of Tumor	Treatment	Exophthalmos	Visual Acuity: On Admission	Visual Acuity: In 1954	Survival in Years	Remarks
14 39 F	Both nerves, chiasm, infundibulum and optic recess of 3rd ventricle	Biopsy only; no radiotherapy	No	R. Light perception L. Light perception	....	0 Died	Diabetes insipidus began 8 months and blurring of vision 4 months before death. Result poor.
15 7 F	Rt. nerve, chiasm, entire 3rd ventricle	4,700 r in 36 days; 2,400 r in 24 days, after 2 years	No	R. 10/200 L. 20/200	R. 15/200 L. 15/200	2.4 Alive in 1955	Size of visual area increased but acuity did not improve. Result fair.
16 9 F	Rt. nerve	Krönlein intra-orbital removal only	Yes	R. Blind L. 20/20	R. No vision L. 20/20	9 Alive in 1955	Has café-au-lait spots. Size of rt. optic foramen decreased on re-examination 5 years after operation. Result good.
17 3 F	Left optic nerve	Krönlein intra-orbital removal only	Yes	R. Normal L. Blind	R. 20/20 L. Blind	5 Alive in 1955	Result good.
18 5 F	Left optic nerve (?) and chiasm	Krönlein intra-orbital removal only	Yes	R. 20/40 L. Blind	R. 20/40 L. Blind	2 Alive in 1955	Continued diminished acuity suggests possible involvement of the other nerve or chiasm. Result poor.
19 1.3 F	Left optic nerve	Krönlein intra-orbital removal only	Yes	Too young	....	?	Lost to follow-up.

* In the first column, the age given is the age (in years) at the time the patient was first admitted to the hospital for treatment. Column 3 gives a summary of radiation therapy for each patient. The dose in r is the total dose of radiation to the tumor calculated from standard depth dose tables and isodose curves. The time for delivery of the entire tumor dose is given in days. In parentheses are given the number of approximately similar series of treatments administered (including the first series) and the number of years over which repeated treatment was extended. Survival in years refers to the documented duration of life after diagnosis of the lesion.

TABLE II: RESULTS OF TREATMENT OF OPTIC NERVE GLIOMAS: VERIFIED BUT UNCLASSIFIED (SIX CASES)*

Case No. Age, and Sex	Location of Tumor	Treatment	Exophthalmos	Visual Acuity: On Admission	Visual Acuity: In 1954	Survival in Years	Remarks
20 4 M	Rt. optic nerve and chiasm	1,250 r in 16 days (×4 in 1 yr.)	Yes	R. Light perception L. 20/20	R. Blind L. 20/20	22 Alive in 1955	Repeat pneumoencephalogram in 1942; no growth of intracranial tumor. Size of optic foramen increased from 8 to 10 mm. in 6 years. Exophthalmos disappeared. Result good.
21 8 M	Both nerves and chiasm	1,200 r in 12 days (×4 in 1 yr.)	No	R. 10/200 L. 10/200	R. 20/70 L. 20/100 (1939)	19 Alive in 1955	Patient now has no difficulty reading. Original ventriculogram showed marked ventricular dilatation. Sella turcica was eroded. Result good.
22 8 F	Rt. nerve and chiasm	1,100 r in 10 days (×3 in 1 yr.)	No	R. 20/25 L. 20/70 Very small field	R. 20/25 L. Hand movement	13 Died	Died of intercurrent disease after 13 years. Result good.
23 11 M	Rt. nerve and chiasm	800 r in 8 days (1 series)	No	R. Blind L. 20/20	R. Blind L. 20/20	11 Died	Marked hypopituitarism. Did not complete radiotherapy. Died at home after frequent convulsions and coma, presumably from cerebral involvement. Result fair.
24 9 F	Rt. nerve and chiasm	1,000 r in 8 days (×2 in 0.5 yr.)	No	R. 5/200 L. 5/70	Vision improved but relapsed	0.5 Died	Result poor.
25 35 F	Rt. nerve and chiasm	5,500 r in 40 days (1 series rotation therapy)	No	R. Light perception L. 15/200	R. 20/200 L. 20/200 Sees 1st letter in 20/70	2.5 Alive in 1955	Disease appears to be arrested, but vision still poor. Result fair.

* See Footnote to Table I.

TABLE III: RESULTS OF TREATMENT OF OPTIC NERVE GLIOMAS: DIAGNOSED CLINICALLY AND RADIOLOGICALLY (NINE CASES)*

Case No., Age, and Sex	Location of Tumor	Treatment	Exophthalmos	Visual Acuity: On Admission	Visual Acuity: In 1954	Survival in Years	Remarks
26 20 M	Left nerve (See remarks)	1,000 r in 21 days (1936) 4,200 r in 36 days (1954)	No	R. 20/40 L. Blind	R. 20/30 L. Blind (Aug. 1955)	20 Alive in 1955	Did not complete treatment in 1936. Pneumoencephalogram in 1954 showed involvement of 3rd ventricle and thalamus. Result good.
27 8 M	Chiasm and rt. nerve. Pneumoencephalogram	800 r in 10 days (×3 in 0.5 yr.)	No	R. Count fingers L. Count fingers	R. Count fingers L. Count fingers	20 Alive in 1955	Hypopituitarism. Patient returned in 1954 with subarachnoid hemorrhage. Result fair.
28 3F	Left nerve and chiasm. Ventriculogram	2,400 r in 30 days; then 2,000 r in 24 days, after 8 months	No	R. Light perception L. Blind	R. 20/20 L. Blind	3 Alive in 1955	Large suprasellar mass. Moderate hydrocephalus. Result good.
29 2 M	Rt. nerve	3,500 r in 44 days; then 2,200 r in 18 days, after 6 months	Yes	R. Light perception L. normal	R. 20/200? Good fixation L. 20/20	2 Alive in 1955	Exophthalmos and 5 diopters of papilledema disappeared completely. Result good.
30 6 F	Rt. nerve and chiasm	1,700 r in 20 days (×2); then 800 r in 9 days, after six months	Yes	R. Blind L. 20/20	R. Blind L. 20/20	5 Alive in 1955	Exophthalmos and 10 diopters of papilledema disappeared completely. Result good.
31 6 M	Both nerves and chiasm	3,100 r in 35 days (1 series)	No	R. 20/50 L. 20/30	R. 20/20 L. 20/30	1 Alive in 1955	Patient has neurofibromatosis. Result indeterminate.
32 49 F	Left nerve and chiasm	2,200 r in 29 days (1 series)	No	R. 20/30 Scotomata L. Blind	R. 20/20 L. Blind	5 Alive in 1955	Scotomata in rt. eye disappeared. Result good.
33 2.5 M	Left nerve	3,000 r in 33 days	Yes	R. Normal L. Blind	R. Normal L. Blind	0.5 Alive in 1955	Four diopters of papilledema at beginning of treatment disappeared. Exophthalmos reduced. Result still indeterminate.
34 40 F	Rt. nerve and chiasm. Pneumoencephalogram	4,000 r in 28 days (1 series)	No	R. 20/70 Hemianopsia L. 20/20 Temporal field cut	R. 20/30 Slight field cut L. 20/15 Full field	0.8 Alive in 1955	Diminished vision in right eye since childhood. Acuity and fields improved 6 weeks after completion of treatment. Result good.

* See Footnote to Table I.

is noteworthy that in the majority there has been significant improvement, with arrest or reversal of visual changes (*e.g.*, Case 34). In one instance growth of the tumor has progressed at a retarded rate.

Exophthalmos constituted an important part of the clinical picture in 10 patients. In 3 cases with marked exophthalmos (Cases 20, 29, and 30) there was complete regression of the globe following radiation therapy. One patient (Case 20), who had proptosis on admission, has been followed twenty-one years without evidence of recurrence of exophthalmos. These objective observations are a most valuable indication of the effectiveness of radiation in shrinking optic nerve gliomas and effecting a prolonged abatement of the disease. Papilledema was present in 3 cases and disappeared completely in all following radiation therapy.

The cause of death in patients with optic glioma usually is extension of the tumor to involve the hypothalamus, third ventricle, and thalamus. Ventricular obstruction is a contributing factor in some instances. Three patients died following surgery, and necropsy showed death to be due to meningitis and encephalomalacia of the hypothalamus.

Of the many and varied benefits received from radiation therapy, few are as dramatic as the restoration of vision. This remarkable result occurred in a significant number of our patients and is particularly well illustrated by Case 3. In this instance the history and clinical course also exemplify numerous features of the disease

process aside from ophthalmologic changes. A summary of the record in greater detail than can be given in the tables is considered worthwhile.

A 6-year-old boy was admitted to the hospital because of fatigability and intermittent headache for one year. For eight months vomiting had been associated with the headaches and there had been pain in the back of the neck, radiating into the right arm, and tilting of the head to the right. No subjective complaint of impaired vision was expressed.

Examination revealed a thin boy who was unsteady when walking a straight line and when standing on either foot alone. The deep tendon reflexes in the lower extremities were hyperactive, more so on the left than the right. The optic disks were pale on the temporal aspects. The disk margins were blurred, cupping was absent on the left, and the veins were distended. The pupils were equal and reacted to light and accommodation, and extraocular movements were normal. A left central facial paresis was present.

Roentgenograms disclosed a marked increase in the convolutional impressions of the inner table of the skull. The coronal and sagittal sutures were considerably widened. The posterior clinoid processes were atrophic, and the tuberculum sellae and floor of the sella turcica were depressed (Fig. 2). The right optic foramen was enlarged to 8 mm. in diameter (similar to Fig. 1). Electroencephalography exhibited a moderately abnormal record but there were no focal signs. Examination of the visual fields revealed a bitemporal hemianopsia with some encroachment upon the nasal field of the right eye (Fig. 3). Visual acuity remained 20/30 in the right eye and was 20/40 in the left eye.

Ventriculography disclosed marked dilatation of the lateral ventricles (Fig. 2). A large suprasellar mass was demonstrated which compressed the anterior two-thirds of the third ventricle and produced an obstruction to the circulation of cerebrospinal fluid. At operation the right optic nerve, the optic chiasm, and to a lesser extent the left optic nerve were found to be greatly enlarged and infiltrated by hard pink tumor. A small specimen was removed from the optic chiasm and pathologic examination showed piloid astrocytoma. No further operative procedure was performed.

Postoperatively the patient received roentgen irradiation, given in five series during a fifteen-month period. In each series a tumor dose of 1,000 r was delivered in two weeks. By the end of the second series the presenting symptoms had disappeared. One year after the operation visual acuity had improved to 20/30 (plus) on the left and 20/20 on the right. At this time enlarged blind spots were present and there were a few scotomata in the temporal fields but no hemianopsia.

Re-examination seven years after operation and five and one-half years after conclusion of roentgen therapy showed the youth to be developing well, with no complaints. Neurologic examination was negative except for paleness of the optic disks and a slight lag of the left corner of the mouth. At this time the visual acuity was 20/20 on the left and 20/15 on the right, and only a small defect in the temporal field of the right eye could be mapped (Fig. 4). It has been suggested that the small scotoma remaining may be the result of biopsy of the optic chiasm.

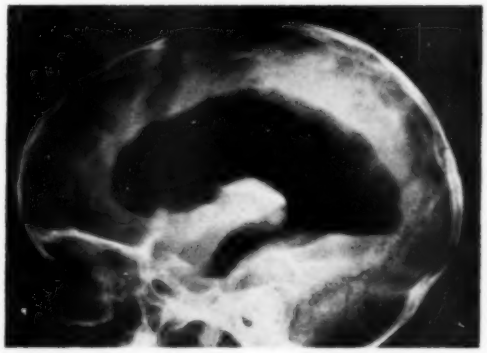


Fig. 2. Case 3. The lateral ventriculogram reveals a suprasellar mass which largely occludes the third ventricle, with resultant dilatation of the lateral ventricles. Widening of the coronal suture, indicating generalized elevation of intracranial pressure, and deformity of the anterior portion of the sella turcica found in many patients with optic glioma (see text) are also shown. The patient was given roentgen therapy and is well, with virtually normal vision, seven years after ventriculography (see Fig. 4).

COMMENT

The prognosis in glioma of the optic nerve and chiasm is favorable in comparison with the majority of infiltrating neoplasms of the nervous system. Almost all of the intrinsic tumors of the optic nerves and chiasm are composed of piloid astrocytes and the natural course of the tumor is one of slowly progressive growth. Death usually results from extension into vital areas and from blockage of the foramen of Monro. The lesions do not require radical surgery and many investigators advise against operation altogether except as required for diagnosis or to relieve obstruction of the cerebrospinal fluid circulation. A possible exception to this general principle is the tumor which is confined to one optic nerve, allowing complete removal. Even in such cases a trial course of radiotherapy may be in order prior to

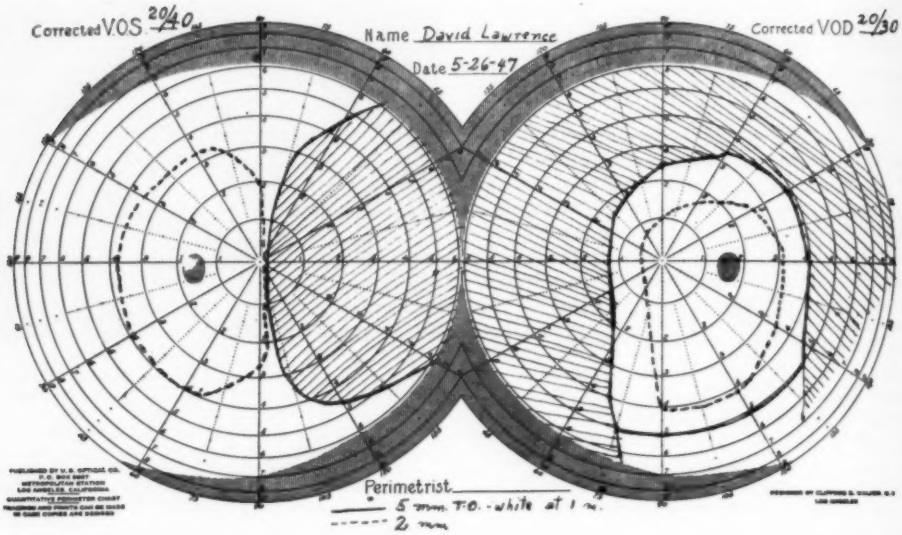


Fig. 3. Case 3. Field of vision at the time of admission. The perimeter is reduced bilaterally, demonstrating a bitemporal hemianopsia. There is also encroachment upon the nasal field of the right eye.

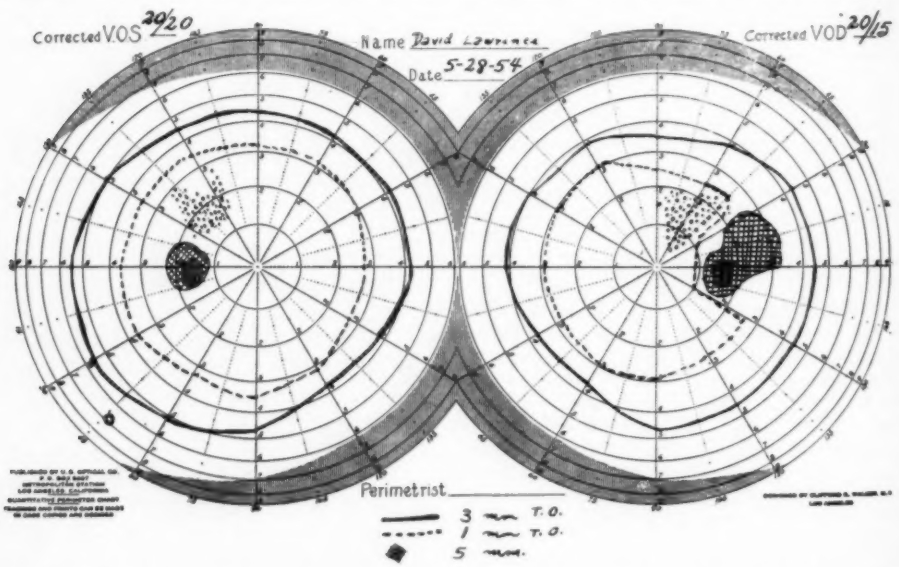


Fig. 4. Case 3. Field of vision seven years after admission. Only a small defect in the temporal field of the right eye remains, together with enlargement of the blind spot on each side. Visual acuity has returned to normal.

surgery. The results in this series, in which irradiation alone not infrequently caused complete and permanent regression of an existing exophthalmos and, in a few instances, led to almost complete restoration of vision in an eye which was thought to be blind, seem to justify this conclusion. The infrequent recurrence of optic gliomas following radiotherapy is remarkable.

The failure of optic nerve gliomas to recur locally after intraorbital removal has been emphasized in the literature, but re-

ports of continued intracranial growth are also found (Werner, 18; Barraquer, 1; Byers, 2; Davis, 4; Verhoeff, 17). It is our opinion, therefore, that in the presence of enlargement of the optic canal, indicating intracranial extension of the neoplasm, surgery should be preceded by radiotherapy. Sometimes surgical removal of an intraorbital glioma has to be performed when, in the absence of enlargement of the optic canal, an etiologic diagnosis cannot be made without exploration.

The degree of response of histologically similar lesions to radiation therapy varied. Large tumor doses often are not necessary to produce beneficial effects, and a strict correlation between the amount of radiation administered and the clinical course cannot be made. Some patients received multiple short series of roentgen treatments, while others were given a single protracted series. Excellent results have been obtained with the multiple course method, in which a tumor dose of 800 to 1,500 r is repeated two or three times during the early months following diagnosis. A critical review of a few cases in this series seems to justify the trend which now exists toward more intensive irradiation. The number of patients who have been treated intensively, however, is small, and sufficient time has not yet elapsed to determine the effects in the present group. Undesirable sequelae to radiation therapy (such as cataracts, pituitary damage, convulsive disorders) have not been encountered.

SUMMARY

Primary tumors of the optic nerves and chiasm are encountered infrequently, with the result that the effect of various forms of therapy has been difficult to evaluate. In the past, emphasis has been placed upon surgery, and the literature does not indicate the importance of irradiation in the management of these neoplasms.

Results of treatment of 34 patients are reported, showing that roentgen irradiation is the procedure of choice in the control of optic nerve glioma. Among the numerous beneficial results, the effect upon vision is outstanding. Treatment has produced in some instances a restoration of vision, while on other occasions advancement of visual impairment has been arrested.

Experience has produced a trend to conservative surgery, chiefly diagnostic craniotomy in obscure cases or relief of the obstruction of cerebrospinal fluid circulation which occurs in some patients. Tumors limited to the orbital cavity, as evidenced by absence of enlargement of an optic canal, have been treated successfully by intra-orbital surgical removal. All other patients should be treated by irradiation.

The possible usefulness of more intensive radiation therapy than has been used in the majority of cases reported in this review is suggested, but the value of higher dosage is not yet established.

Neurological Institute
622 West 168th St.
New York 32, N. Y.

REFERENCES

1. BARRAQUER, J.: Mixoma quistico del nervio optico, de la papila y retina derechas y de la cavidad craneal y orbita izquierda. Arch. de oftalmol. hispanoamericanos **2**: 132–139, 1902.

2. BYERS, M. G.: The Primary Intradural Tumors of the Optic Nerve (Fibromatosis Nervi Optici). Studies from the Royal Victoria Hospital, Vol. I, No. 1, 1901, pp. 1–82.

3. CUNEO, H. M., AND RAND, C. W.: Brain Tumors of Childhood. Springfield, Ill., Charles C Thomas, 1952, pp. 126–143.

4. DAVIS, F. A.: Primary Tumors of the Optic Nerve (a Phenomenon of Recklinghausen's Disease). Clinical and Pathologic Study with Report of 5 Cases and Review of the Literature. Arch. Ophth. **23**: 735, April; 957, May 1940

5. DYKE, C. G., AND DAVIDOFF, L. M.: Roentgen Treatment of Diseases of the Nervous System. Philadelphia, Lea & Febiger, 1942, pp. 100–103.

6. EMANUEL, C.: Über die Beziehungen der Sehnervengeschwülste zur Elephantiasis neuromatodes und über Sehnervengliome. Arch f. Ophth. **53**: 129–161, 1902.

7. GRINKER, R. R.: Tumors of the Optic Nerve. Arch. Ophth. **4**: 497–508, October 1930.

8. VON HIPPEL, E.: Die Krankheiten des Sehnerven In VON GRAEFE, A., AND SAEMISCH, E. T.: Handbuch der gesamten Augenheilkunde. Berlin, Julius Springer, Vol. 7, Part 2, 1923.

9. HUDSON, A. C.: Primary Tumors of the Optic Nerve. Roy. London Ophth. Hosp. Rep. (Part 3) **18**: 317–439, 1912.

10. LUNDBERG, Å.: Über die primären Tumoren des Sehnerven und der Sehnervenkreuzung. Inaugural Dissertation, Karolinska Institute. Stockholm, Nordiska Bokhandeln, 1935.

11. MARTIN, P., AND CUSHING, H.: Primary Gliomas of the Chiasm and Optic Nerves in Their Intra-

cranial Portion. Arch. Ophth. **52**: 209–241, May 1923.

12. PARSONS, J. H.: Diseases of the Eye. New York, Macmillan Co., 8th ed., 1936, p. 647.

13. PFEIFFER, R. L.: Roentgenography of Exophthalmos with Notes on the Roentgen Ray in Ophthalmology, Part III. Am. J. Ophth. **26**: 928–942, September 1943.

14. PFEIFFER, R. L.: Personal communication.

15. RICHMOND, J. J.: Radiotherapy of Intracranial Tumours in Children. J. Fac. Radiologists **4**: 180–189, January 1953.

16. VERHOEFF, F. H.: Primary Intraneural Tumors (Gliomas) of the Optic Nerve. Arch. Ophth. **51**: 120–140, March 1922.

17. VERHOEFF, F. H.: Tumors of the Optic Nerve. In Cytology and Cellular Pathology of the Nervous System, Vol. III. W. G. Penfield, editor, New York, Paul B. Hoeber, Inc., 1932, pp. 1029–1039.

18. WERNER, M. B.: Two Cases of Primary Intradural Tumor of the Optic Nerve, in One of Which the Tumor Was Removed by Krönlein's Operation, with Preservation of the Eye. Tr. Ophth. Soc. United Kingdom **23**: 77–103, 1903.

19. WOLF, A., AND COWEN, D.: Personal communication.

SUMARIO

El Valor de la Radioterapia en la Asistencia del Glioma de los Nervios y del Quiasma Optico

Preséntase una serie de 34 casos de glioma del segundo par y del quiasma óptico: 19 casos fueron comprobados histopatológicamente, 9 diagnosticados únicamente a base de la inspección quirúrgica macroscópica y 7 por el examen clínico y radiológico sin intervención cruenta. Veintiséis de los enfermos tenían menos de quince años de edad. El hallazgo radiológico más frecuente fué dilatación de un agujero óptico, presente esto en 24 casos. En 2 casos, estaban dilatados ambos agujeros ópticos. Todos los enfermos tenían signos neurológicos y oftalmológicos de un tumor primario que ocluía las vías visuales.

En el tratamiento de estos tumores se usaron tanto la roentgenoterapia como la cirugía. En la mayoría, la cirugía se limitó a la comprobación de la lesión mediante la inspección macroscópica, con o sin biopsia. De 22 enfermos tratados hace más de cinco años, 15 vivieron más de cinco años después de aplicarse la irradiación. En 8 de éstos, hubo restablecimiento de la visión perdida o estacionamiento de la pérdida visual en camino. En los otros sobrevivientes, hubo avance lento de la incapacidad visual, pero sin signos de difusión del tumor más allá del nervio y del quiasma ópticos. En 3 casos tardíos, hubo regresión absoluta de una exoftalmía grave.

La irradiación roentgen está considerada como el tratamiento de elección, con limitación de la cirugía a la craneometría para el diagnóstico en los casos obscuros o el alivio de la oclusión de la circulación del líquido céfalorraquídeo.

Los primeros casos de los AA. (hasta 1950) recibieron tres series de roentgenoterapia, administrándoseles 1,300 r (dosis tumor) por serie en un período de ocho a veintiún días, por lo general con un intervalo de seis semanas entre series. Más recientemente, se ha administrado una sola serie prolongada de tratamiento, con una mínima dosis tumor básica de 4,000 r en vientiocho días. Para los niños de menos de ocho años se rebaja la dosis.

Ewing's Sarcoma: Its Roentgen Classification and Diagnosis[1]

ROBERT S. SHERMAN, M.D., and KENNETH Y. SOONG, M.D.

In 1921, James Ewing identified a form of primary malignant bone tumor which he designated "diffuse endothelioma" or "endothelial myeloma" (7). This lesion is commonly known today as Ewing's sarcoma or Ewing's tumor. While the clinical and pathological aspects have been amply stressed in a number of reports covering large series of cases (4, 5, 14, 15, 21), the literature on roentgen diagnosis (1, 10, 11, 13, 16, 18, 20) is relatively incomplete; there is no study based on a sufficient volume of dependably proved material with x-ray diagnosis as the primary object. Much of the writing pertaining to the roentgen aspects has been done by those not fully oriented in this specialty. Furthermore, since the pathological identification of this lesion may be extremely difficult, some of the cases upon which discussion of x-ray diagnosis has been based are open to question.

MATERIAL

After careful scrutiny, 111 cases of Ewing's sarcoma from the files of Memorial Center (New York) were considered satisfactory for the present investigation. These were selected on the basis of adequate roentgen coverage, dependability of histologic diagnosis, and clinical correlation. The histologic proof was furnished by Drs. James Ewing, Fred Stewart, or members of their staff in the Department of Pathology. As far as we know, this is by far the largest single series of Ewing's sarcoma studied on the basis of roentgen diagnosis alone.

The group was composed of 77 males and 34 females. The male preponderance, approximately 2 to 1, is in keeping with the ratio found in other series.

The age distribution by decades is as follows: 29 cases up to the age of nine, 47 between the ages of ten and nineteen, 30 between twenty and thirty, and 5 from thirty years on. Of the 29 patients below ten years of age, only 4 were under two. The tumor is known to be rare among infants and older adults; it is found primarily in adolescence, with the highest incidence between ten and nineteen years. The average age in this series was fifteen years, the youngest patient was seven months, and the oldest was thirty-six years.

No example of a primary tumor in the skull, mandible, or vertebra was encountered, although a few such cases have been reported in the literature (14). Metastases, however, were found in all parts of the skeleton. The skeletal distribution of the 111 cases is as follows:

Long bones	63 cases
Femur	38
Fibula	8
Humerus	7
Tibia	7
Radius	2
Ulna	1
Ribs	16 cases
Pelvis	18 cases
Ilium	10
Pubis	3
Ischium	3
Sacrum	2
Scapula	10 cases
Small Bones	4 cases
Os calcis	2
Metatarsals	2

ROENTGEN DIAGNOSIS

It was deemed necessary, in this study, to divide the tumors into two main groups. On the basis of their skeletal location, they were separated into those in the long bones and those in the remainder of the skeleton. The long-bone neoplasms were further subdivided according to the particular part of the bone involved. The

[1] From the Department of X-Ray Diagnosis, Memorial Center, New York, N. Y. Accepted for publication in March 1955.

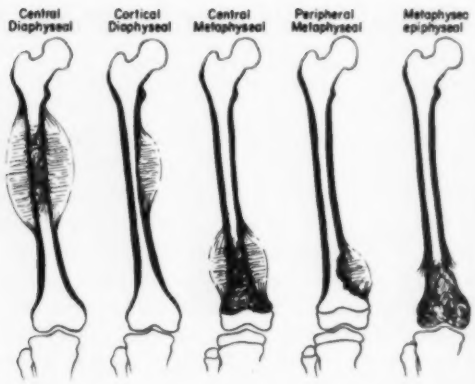


Fig. 1. Types of Ewing's sarcoma in the long bones.

reason for this was the resemblance in roentgen characteristics which was found among tumors of similar location.

Long Bones

Great variation was noted in the roentgen appearance of Ewing's sarcoma of the long bones, with only 29 of the 63 cases considered to present a classical picture. Similarity among tumors in the same location in the long bones, however, justified classification of various roentgen types of Ewing's sarcoma as follows (see also Fig. 1).

Diaphyseal	
Central	29
Cortical	12
Metaphyseal	
Central	6
Peripheral	10
Epiphyseal	6
	63

This incidence of the different roentgen types is subject to slight qualification, because in a few instances the initial classification could have been changed later in the course of the disease.

Central Diaphyseal: This type of lesion, generally considered to be the classical roentgen form of Ewing's tumor, constituted almost half of the long-bone tumors and hence is most important from the standpoint of numbers. While most of these tumors presented a classical picture, there was a subgroup composed of 6 variant lesions which will be described at the end of this section.

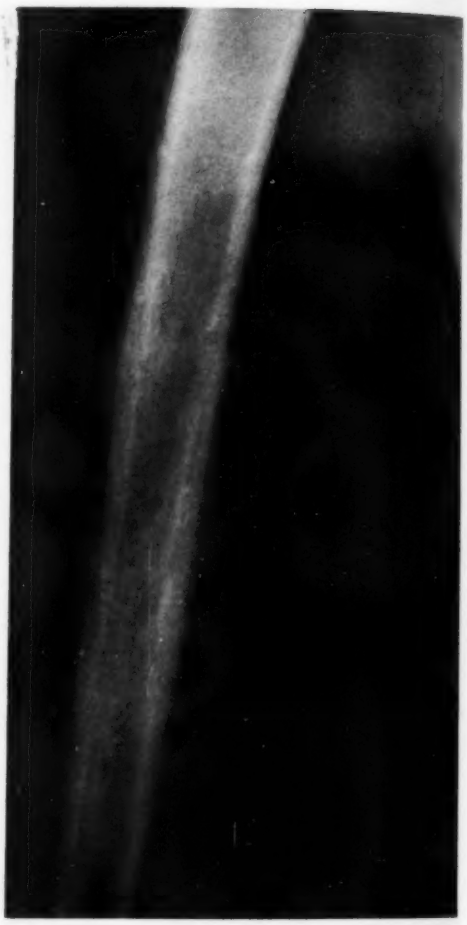


Fig. 2. Classical appearance of Ewing's sarcoma.

The typical roentgen features, displayed in 23 tumors, were essentially as follows: mid-shaft location, long extent of the new growth usually involving about one-third of the shaft, fusiform configuration, frequent involvement of soft parts, fine patchy internal pattern of bone destruction, ill-defined edges, and a parallel form of periosteal reaction. The neoplasms were symmetrical in position, and it thus would seem that they had a central origin in the medullary canal. The direction of growth is believed to have been largely along the shaft, but early extension

outward, through the cortex into the soft parts, was also evident. Bone destruction was found consistently. In 21 cases it was seen as a fine, patchy mottling which led to an appearance of "cracked ice" (Fig. 2). Somewhat larger and more circular areas of bone loss were observed in 8 instances. No example of punched-out, discrete lesions was found, nor was any large uniform area of complete destruction encountered. Pathological fracture was demonstrated on the initial films in 8 patients and subsequently occurred in 4. There was no clear evidence of productive or sclerotic changes within the bone itself.

Some degree of cortical destruction was the rule. This took two main forms: (*a*) endocortical erosion and (*b*) lace-like longitudinal destruction. The former was occasionally somewhat masked as a result of the cortical thickening caused by subperiosteal new-bone formation. The boundary was ill-defined within the bone and in the soft parts.

Two types of periosteal reaction were noted. The parallel or laminated form was observed in all instances. In 15 cases (about 50 per cent), however, perpendicular periosteal spiculation was also seen; in no instance was the latter observed alone. When the perpendicular spicules were prominent, they were demonstrated in the center of the tumor, with the laminated layers at each end presenting a triangular, cuff-like appearance. The tumor seemed to grow into the soft parts in the center, through the periosteum, and was limited by the latter at the ends (Fig. 3).

The "onion peel" or laminated periosteal reaction in Ewing's sarcoma has been overemphasized in the past. In the presence of this form of reaction, however, Ewing's tumor should in most cases at least be considered. Moreover, in some instances in which radiography was technically imperfect in regard to bone detail, cortical or medullary bone involvement was not visible and the laminated periosteal reaction only could be identified.

Involvement of soft parts was almost invariably present in the form of an ill-defined mass or diffuse swelling in the tumor region. In none of these extensions did a significant degree of calcification develop; only a few showed one or two minute calcific flecks close to the area of periosteal reaction. None of the tumors were predominantly sclerotic. All sclerotic or dense neoplasms in the long bones were limited to the metaphyses.

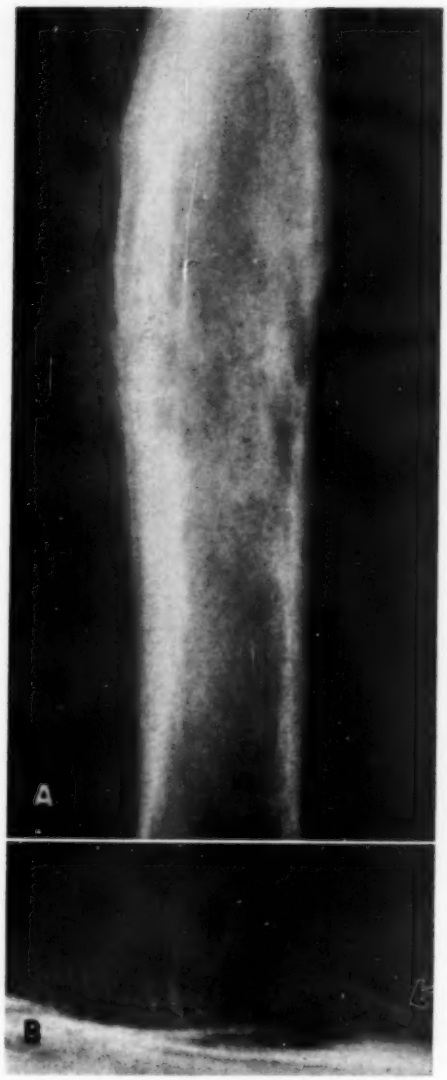


Fig. 3. A. View of laminated periosteal reaction at ends of Ewing's tumor, with perpendicular periosteal reaction in center, best shown in B.

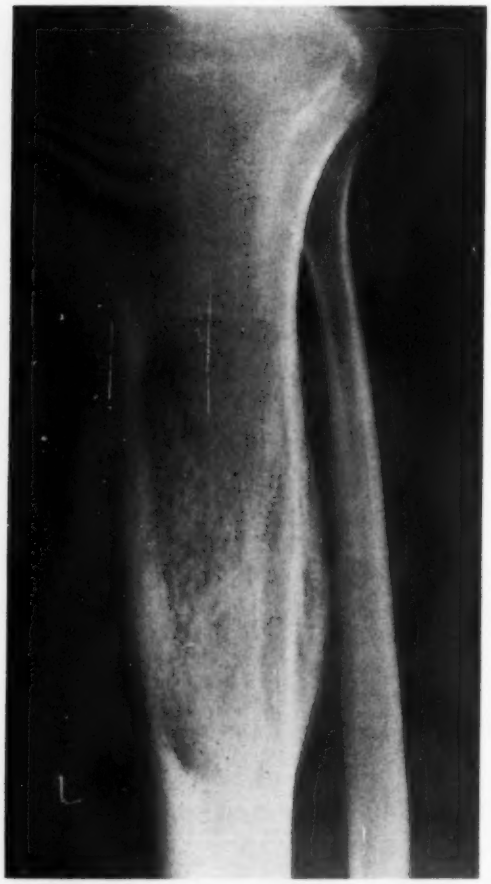


Fig. 4. Variant of the classical radiographic type of Ewing's sarcoma, showing somewhat more distinct edges and endocortical thinning.

The 6 variant tumors encountered were all in the mid-shaft, involving one-third of the entire bone, producing a fusiform enlargement or expansion. There were a fine reticulated internal pattern, endocortical thinning and erosion, and laminated periosteal reaction, usually of several layers. Fairly well defined edges and a greater degree of endocortical thinning, causing a more definite and confluent area of bone destruction and bone enlargement, were the special features of the variant (Fig. 4).

Cortical Diaphyseal: The most characteristic feature of this category was cortical erosion of varying degree, involving the outer surface of the cortex while the inner surface remained intact (Fig. 5). Marked discrepancy was noted between the size of the extra-osseous soft-tissue component and its osseous counterpart; the former was by far the larger. In contrast with the classical or central diaphyseal type, these tumors were invariably asymmetrical, usually involving less than one-fourth of the bone length. They were found at or near the mid-shaft level and were usually oval in shape. The direction of the growth seemed to be external to the bone rather than internal. Cortical erosion was seen as a saucerized irregular defect, with the central crater facing the outer surface, occasionally exhibiting a marginal scalloping effect. No pathological fracture was noted. In 1 instance, an unusual amount of calcification was observed. At the ends of the tumor the laminated periosteal reaction prevailed, while in the center coarse, irregular, widely spaced vertical spicules were visualized.

Central Metaphyseal: Each of the 6 tumors in this group was symmetrically located in the metaphysis of a long bone, growing toward the diaphysis. The tumors were usually pear-shaped. It was interesting to note that in 5 of the 6 the epiphysis was not closed, indicating that the epiphyseal line constituted a barrier to tumor growth. In addition to the difference in location, these lesions also varied from the classic type in diversity of the internal pattern. Although patchy bone destruction was always seen, sclerotic changes were not infrequent. There were two predominantly sclerotic sarcomas (Fig. 6A), 2 mixed, and 2 lytic (Fig. 6B). Pathological fracture was noted in 1 instance. Periosteal reactions of both types, laminated and perpendicular, were invariably present, with an accompanying soft-tissue mass.

Peripheral Metaphyseal: Eccentric metaphyseal location, a position assumed by osteogenic sarcoma, was the outstanding feature of this group (Fig. 7). In 2 cases, the lesions were purely lytic, being located eccentrically in the metaphysis, with a

spherical soft-tissue mass and periosteal reaction. They had the roentgenologic earmarks of an osteolytic type of osteogenic sarcoma. Three cases, occurring in the proximal end of the humerus, showed principally a soft-tissue tumor and a relatively minor amount of cortical erosion.

Metaphyseal-Epiphyseal: Contrary to the general belief that the epiphysis is not affected in Ewing's sarcoma, 6 instances were encountered in which this part of the bone was invaded. There was, however, no clear-cut example of epiphyseal involvement alone. In 2 cases, minute

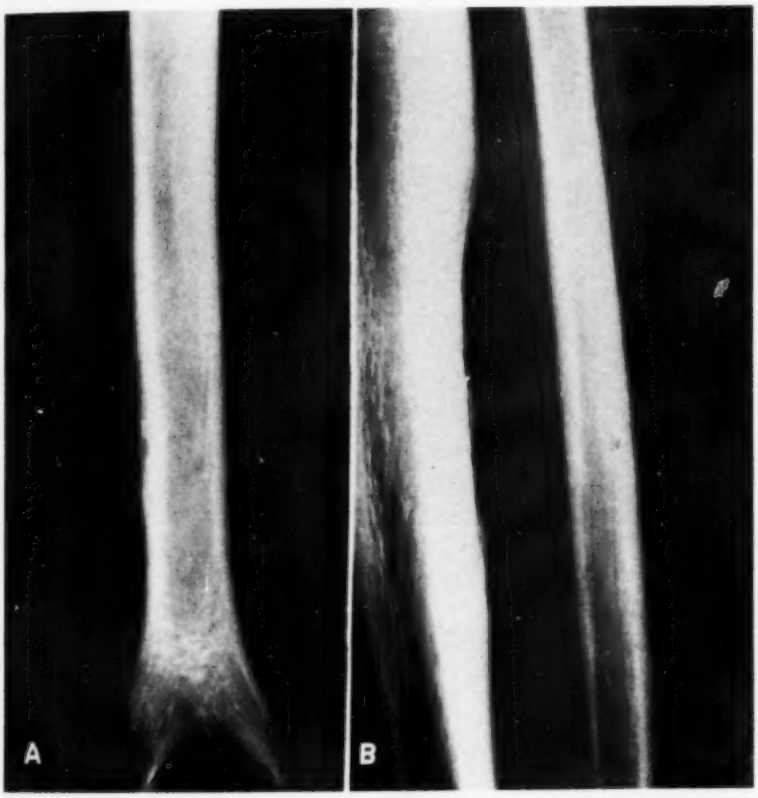


Fig. 5. A. Small area of cortical destruction which may be encountered in the cortical diaphyseal type of Ewing's sarcoma.
B. Moderately large exocortical destruction, with soft-tissue mass and prominent perpendicular periosteal reaction, indicating the cortical diaphyseal type of Ewing's tumor.

The impression was that of a soft-tissue tumor secondarily invading the bone or even of the periosteal type of osteogenic sarcoma. The other 5 tumors simulated the mixed type of osteogenic sarcoma, as all were eccentrically located in the metaphyseal region, presenting equal amounts of bone destruction and production along with a periosteal reaction and soft-tissue mass.

bone destruction was demonstrated initially at the epiphyseal line in such a way that one could not be certain whether the epiphysis or metaphysis or both were involved. Subsequently, the entire epiphysis and metaphysis became diseased (Fig. 8). As a result, the epiphysis as the primary tumor site cannot be entirely excluded. The epiphyseal line was closed in 5 out of 6 cases.

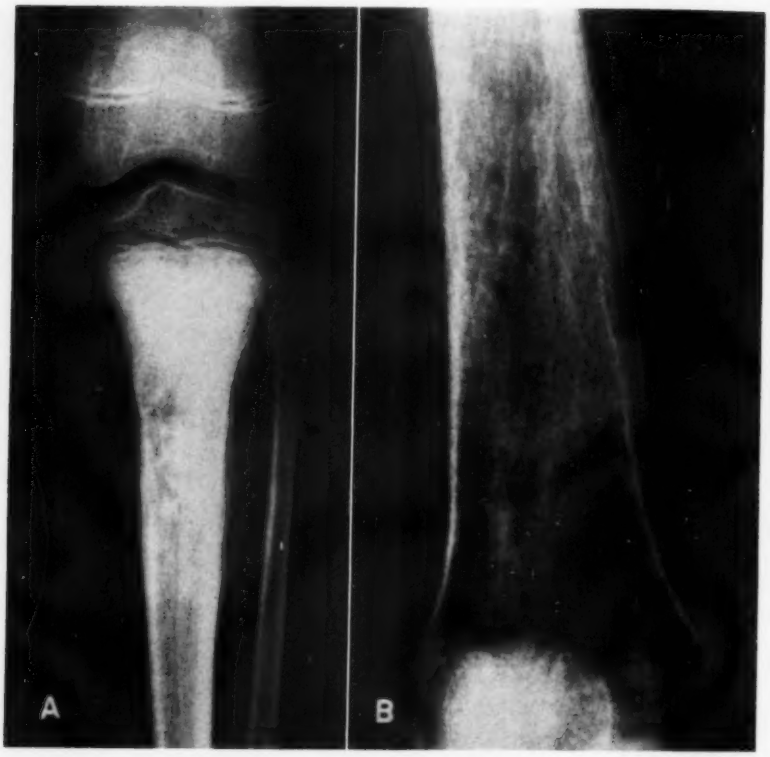


Fig. 6. A. An example of the sclerotic central metaphyseal type of Ewing's sarcoma. B. A lytic form of central metaphyseal Ewing's sarcoma.

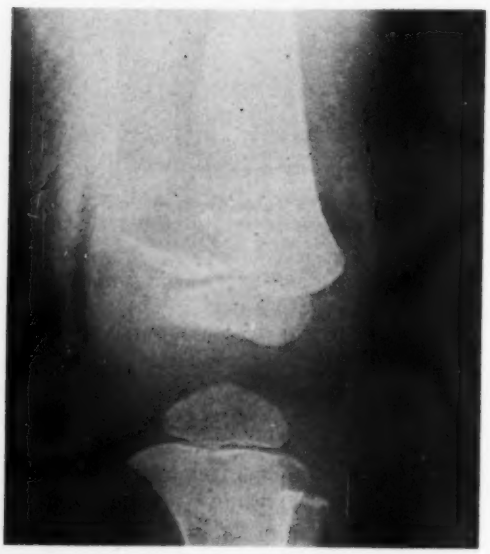


Fig. 7. A lytic form of the peripheral metaphyseal Ewing's sarcoma.

Two of the tumors were lytic, asymmetrically positioned, and centered at the epiphyseal line, as mentioned above. The third case is especially noteworthy because of a great amount of bone production with abundant perpendicular and laminated periosteal reaction (Fig. 9). The fourth was purely lytic, involving the entire epiphysis and metaphysis. In the last 2 cases, extensive bone destruction and pathological fractures were evident.

Small Tubular Bones

There were 2 tumors in the metatarsals. One was of the central diaphyseal variety, and the other of the central metaphyseal type. The findings were essentially the same as those described for long bones.

Ribs

The most striking features of Ewing's

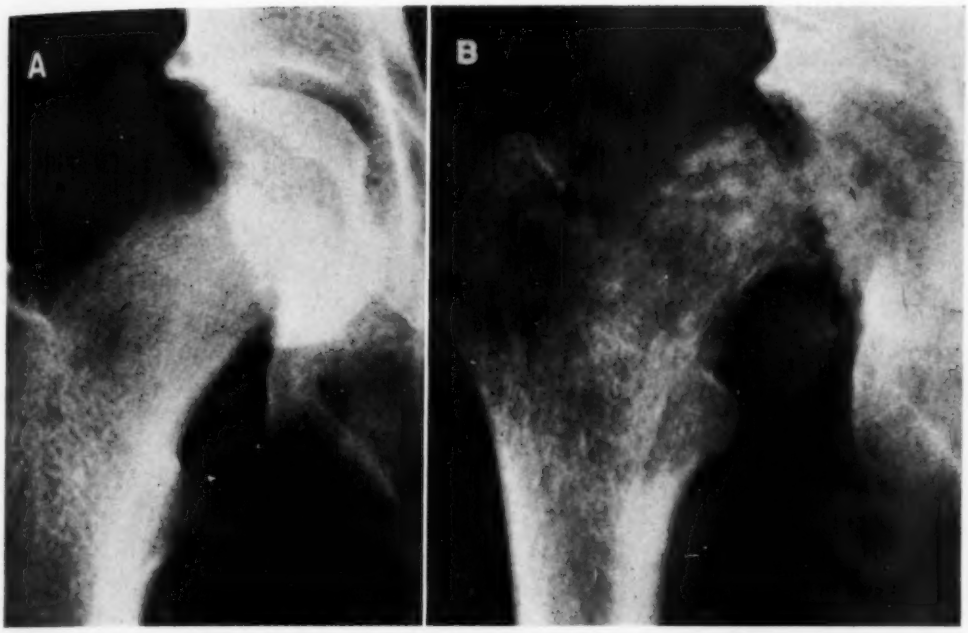


Fig. 8. A. Ewing's sarcoma beginning as a small area of destruction at the head and neck region. The epiphysis is closed.
B. The same tumor about five weeks later, showing rapid growth, fracture, and destruction of the femoral head.

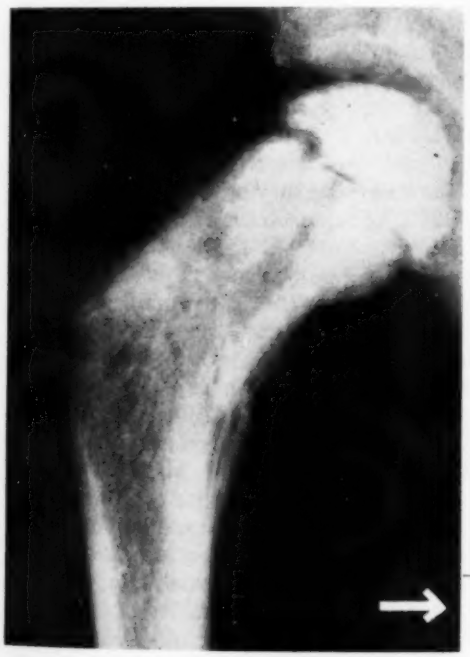


Fig. 9. A sclerotic Ewing's tumor, demonstrating epiphyseal involvement, even though the epiphysis is open.

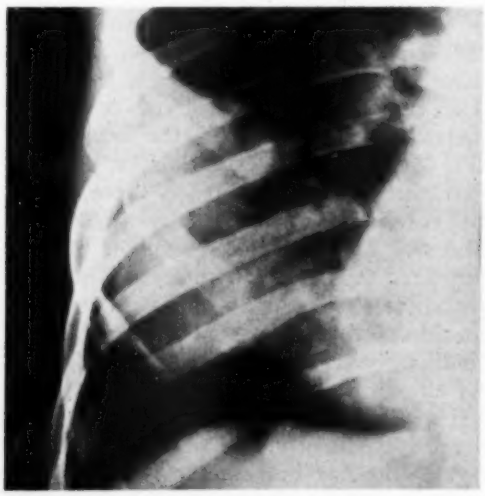


Fig. 10. Ewing's sarcoma of the rib with a prominent soft-tissue mass.

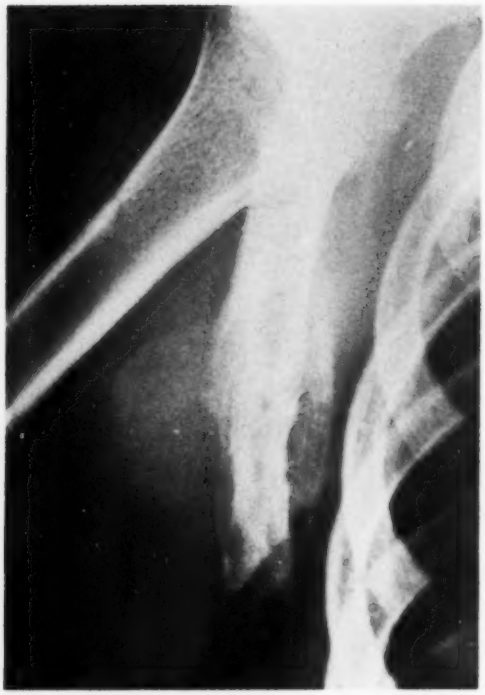


Fig. 11. Example of Ewing's tumor of the scapula.

tumor in the rib was a spherical, intrathoracic mass of water density, found in association with the bone lesion (Fig. 10). The tumors thus seemed to be asymmetrically distributed in the bone with this intrathoracic extension, while the extrathoracic component, as far as could be determined, was usually smaller or absent. The direction of tumor growth appeared to be intrathoracic, and in most instances there was no periosteal reaction on the external surface of the bone. These findings have been noted previously (3). Of the 16 rib lesions, 8 were in the midaxillary line, 5 were anterior, and 3 extended posteriorly. Most of the tumors were spherical in shape, with 6 cm. as the average diameter. One-fourth to one-third of the rib length was involved in most instances. Thirteen of the tumors were predominantly lytic. All 4 cases in the anterior portion of the rib revealed a characteristic fusiform expansion with cortical thinning and finely reticulated internal pattern. Sclerosis was observed in 3 of the neoplasms; cortical thickening and obliteration of the medullary cavity were also noted in these instances. The periosteal reaction was relatively insignificant; a minute amount of irregular lamination was seen in only 6 cases.

Flat Bones

Ewing's sarcoma occurring in the flat bones offered no findings that could be depended upon for roentgen identification. In general, these tumors appeared either in a lytic, sclerotic, or mixed form and therefore resembled other malignant tumors, such as osteogenic sarcoma, reticulum-cell sarcoma, metastases of various kinds, some tumor-like lesions of bone, and certain infections.

Scapula: There were 10 cases arising in the scapula, constituting approximately 8 per cent of the total (Fig. 11). Practically all parts of the bone were involved. In 3 the lesion was in the inferior angle, in 2 near the spinous process, and in 4 at the lateral border or near the glenoid fossa; in 1 almost the entire bone was destroyed. The tumors were usually symmetrical. They ranged from 5 to 12 cm. in greatest diameter, the average being about 8 cm. The shape was usually oval, but 2 of the lesions were spherical. Sclerotic borders were conspicuously absent and medullary origin seemed to be the rule. Bone destruction was invariably present, with 4 of the lesions lytic and 6 mixed. The internal bone pattern ranged from finely patchy to uniformly lytic. In most cases there were fine patches of destruction, coarse strands, or an irregular soap-bubble appearance. Various degrees of destruction were demonstrated in the cortex. Periosteal reaction of laminated or perpendicular type was seen in 6 instances, while in 4 the occurrence of a periosteal reaction could not be ascertained because of the location of the tumor. All cases showed a soft-tissue mass; minimal calcific flecks, presumably of periosteal origin, were found in 6, and massive calcification in 1.

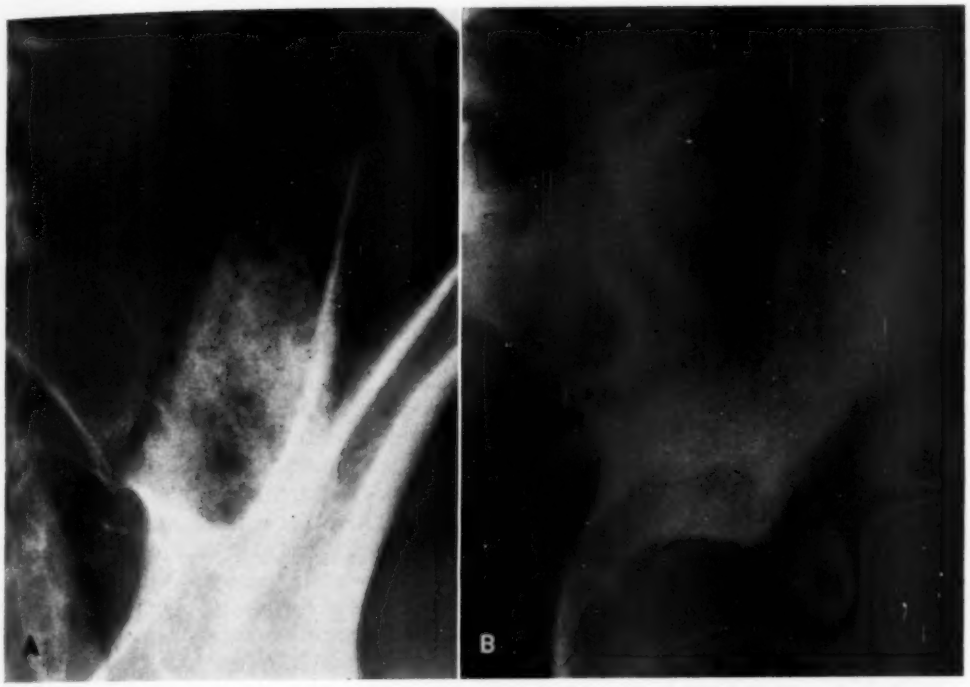


Fig. 12. A. A mixed form of Ewing's sarcoma in the wing of the ilium adjacent to the sacroiliac joint.
B. A predominantly sclerotic Ewing's tumor occupying most of the ilium.

Pelvis: All of the pelvic bones were involved, with the ilium as the most frequent site, in 10 of the 18 cases. The 7 cases involving the iliac wing presented somewhat characteristic roentgen findings. These lesions were usually located near the sacroiliac joint, involving about one-third of the bone. In 4 cases, they were of mixed type, showing an internal pattern of reticulated and stellate radiating spicules with a soft-tissue mass (Fig. 12A). The other 3 were predominantly sclerotic, giving a "cotton-wool" appearance (Fig. 12B). The pubic rami were involved in 3 instances. Of the 3 tumors in the ischium, 2 were in the tuberosity and 1 in the inferior ramus. They were sclerotic, mixed, and lytic in character. Both tumors in the sacrum were lytic, one entirely so and the other presenting a reticulated pattern. The fourth and fifth sacral segments also were the sites of lesions.

Tumors in the *os calcis* were observed in 2 patients. One of these lesions was purely lytic and the other predominantly sclerotic. Their roentgen appearance was by no means characteristic.

METASTASES

An estimate of the incidence of bone metastases was not attempted because complete skeletal surveys were not available in all patients. Our experience indicated that such metastases were common and constituted an important feature in roentgen diagnosis. The metastases in the long bones tended to present a roentgen picture somewhat similar to that of the primary tumor, so that differentiation between the two often would be impossible were it not for a difference in onset and size (Fig. 13).

Metastasis to the lung was frequently observed, with approximately two-thirds of the patients developing such deposits during their course. The roentgen appearance, resembling that generally attributed to sarcoma metastasis, was char-

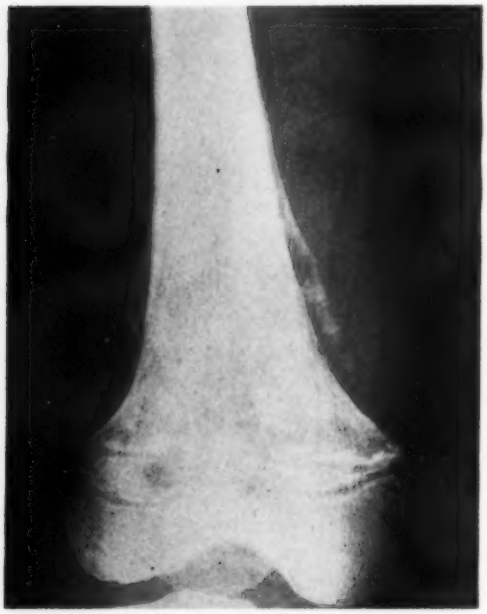


Fig. 13. Metastasis of Ewing's sarcoma.

acterized by multiple nodules of varying size. These nodules, on the whole, were radiosensitive. No ossified or calcified metastasis in the lung was observed.

RADIATION RESPONSE

The favorable radiation response of Ewing's sarcoma has been regarded as most important in roentgen diagnosis. Our experience supports this view, the majority of patients having responded well to x-ray therapy. A tissue dose of approximately 3,000 to 4,000 r, delivered in less than two weeks, is considered to be adequate. In our series, the radiation effects usually were visible roentgenologically about one month following treatment. Subsidence of the soft-tissue mass, with what appeared to be an interval increase of vertical spiculation, was noted initially. These spicules later fused, forming new bone, with incorporation of the laminated layers of periosteal reaction, resulting in cortical thickening. The internal pattern also manifested dramatic change, with repair of bone destruction leaving little or no scarring. In our experience these radiation effects should be manifest within six weeks following adequate therapy, if they are to occur at all. After such treatment the bone frequently was quite normal in appearance. In some instances, minimal bowing and cortical thickening persisted.

DIFFERENTIAL DIAGNOSIS

The roentgenologist is rarely, if ever, justified in making Ewing's sarcoma his sole diagnosis. Less than 1 out of 4 of the lesions presents the classic roentgen picture, and even then the condition is difficult to distinguish from certain cases of osteomyelitis, cancer metastases, malignant lymphoma, osteogenic sarcoma, reticulum-cell sarcoma, the reticuloendotheliosses, and other diseases. All other radiologic types, with the exception of the cortical epiphyseal lesions, which are quite suggestive of Ewing's sarcoma, offer greater difficulties in differential diagnosis, so that in the three metaphyseal forms another kind of lesion, usually osteogenic sarcoma, is commonly diagnosed. Finally, the roentgen appearance of Ewing's sarcoma in the flat bones is particularly difficult to identify specifically.

Realization of the complexity of the differential diagnosis of this tumor should indicate caution to the roentgenologist, but at the same time should make him more alert to the occurrence of this deadly disease under circumstances in which such a possibility previously might not have seemed likely.

SUMMARY AND CONCLUSIONS

1. One-hundred and eleven cases of histologically proved Ewing's sarcoma have been studied roentgenologically.

2. The lesion was found to vary according to its location in long or flat bones, as well as in different parts of the long bones.

3. A description of the x-ray appearance of the tumor in these various sites is given.

4. A classification of the roentgen types of Ewing's sarcoma is presented.

5. Ten per cent of Ewing's sarcomas were found to be of the sclerosing form, roentgenographically.

6. A brief discussion of the problems of roentgen diagnosis is included.

Memorial Center
444 E. 68th St.
New York 21, N. Y.

REFERENCES

1. AHLSTRÖM, C. G., AND WELIN, S.: Zur Differentialdiagnostik der Ewingschen Sarkome; ein Beitrag zur Kenntnis der primären Retikulumzellensarkome des Skeletts und der sog. eosinophilen Granuloma. Acta radiol. **24:** 67–81, 1943.

2. BARDEN, R. P.: Similarity of Clinical and Roentgen Findings in Children with Ewing's Sarcoma (Endothelial Myeloma) and Sympathetic Neuroblastoma. Am. J. Roentgenol. **50:** 575–581, November 1943.

3. BERGSTRAND, H.: Four Cases of Ewing Sarcoma in Ribs. Am. J. Cancer **27:** 26–36, May 1936.

4. COLEY, B. L., HIGINBOTHAM, N. L., AND BOWDEN, L.: Endothelioma of Bone (Ewing's Sarcoma). Ann. Surg. **128:** 533–560, September 1948.

5. CONNOR, C. L.: Endothelial Myeloma, Ewing: Report of Fifty-Four Cases. Arch. Surg. **12:** 789–829, April 1926.

6. DESJARDINS, A. U., MEYERDING, H. W., AND LEDDY, E. T.: Radiotherapy for Endothelioma of Bone. Am. J. Roentgenol. **38:** 344–351, August 1937.

7. EWING, J.: Diffuse Endothelioma of Bone. Proc. New York Path. Soc. **21:** 17–24, January–May 1921.

8. FOOTE, F. W., JR., AND ANDERSON, H. R.: Histogenesis of Ewing's Tumor. Am. J. Path. **17:** 497–502, July 1941.

9. CHARPURE, V. V.: Endothelial Myeloma (Ewing's Tumor of Bone). Am. J. Path. **17:** 503–508, July 1941.

10. HARRISON, R. S.: Ewing's Bone Sarcoma. Brit. J. Radiol. **7:** 580–590, October 1934.

11. KIRKLIN, B. R., AND WEBER, H. M.: A Roentgenologic Consideration of Endothelial Myeloma. Am. J. Roentgenol. **21:** 355–360, April 1929.

12. KOLODNY, A.: Bone Sarcoma. Surg., Gynec. & Obst. **44:** Part II, April 1927, pp. 126–154.

13. LATTMAN, I.: A Review of Ewing's Tumour with Case Reports. Brit. J. Radiol. **7:** 194–207, April 1934.

14. MCCORMACK, L. J., DOCKERTY, M. B., AND GHORMLEY, R. K.: Ewing's Sarcoma. Cancer **5:** 85–99, January 1952.

15. LICHTENSTEIN, L., AND JAFFE, H. L.: Ewing's Sarcoma of Bone. Am. J. Path. **23:** 43–77, January 1947.

16. NEELY, J. M., AND ROGERS, F. T.: Roentgenological and Pathological Considerations of Ewing's Tumor of Bone. Am. J. Roentgenol. **43:** 204–210, February 1940.

17. STOUT, A. P.: A Discussion of the Pathology and Histogenesis of Ewing's Tumor of Bone Marrow. Am. J. Roentgenol. **50:** 334–342, September 1943.

18. SYCAMORE, L. K., AND HOLMES, G. W.: Endothelial Myeloma (Ewing's Tumor). Am. J. Roentgenol. **18:** 223–230, September 1927.

19. SWENSON, P. C.: The Roentgenologic Aspects of Ewing's Tumor of Bone Marrow. Am. J. Roentgenol. **50:** 343–353, September 1943.

20. SWENSON, P. C., AND TEPLICK, J. G.: An Unusual Case of Ewing's Sarcoma. Radiology **45:** 594–598, December 1945.

21. WANG, C. C., AND SCHULZ, M. D.: Ewing's Sarcoma. Study of 50 Cases Treated at Massachusetts General Hospital, 1930–1952, Inclusive. New England J. Med. **248:** 571–576, April 2, 1953.

22. WILLIS, R. A.: Metastatic Neuroblastoma in Bone Presenting the Ewing Syndrome, with Discussion of "Ewing's Sarcoma." Am. J. Path. **16:** 317–332, May 1940.

SUMARIO

El Sarcoma de Ewing; Su Clasificación y Diagnóstico Roentgenológicamente

Los hallazgos actuales se basan en un estudio radiológico de 111 casos de sarcoma de Ewing, comprobados histológicamente. La naturaleza de la lesión varió, conforme a su localización en huesos largos o planos, así como en diversas partes de los huesos largos. Preséntanse una descripción del aspecto roentgenológico en los varios sitios y una clasificación de las formas roentgenográficas.

El radiólogo rara vez, o nunca, está justificado en hacer el sarcoma de Ewing su único diagnóstico. Menos de 1 de cada 4 lesiones presenta el clásico aspecto roentgenológico, y aun entonces es difícil diferenciar la dolencia de ciertos casos de osteomielitis, metástasis cancerosas, linfoma maligno, sarcoma osteógeno, sarcoma retículocelular, las retículoendotoliosis y otras afecciones. En las demás formas radiológicas del sarcoma de Ewing, el diagnóstico diferencial resulta todavía más difícil, de modo que en las tres formas metafisarias se diagnóstica comúnmente otra clase de lesión, por lo general sarcoma osteógeno. Por fin, el aspecto roentgenológico del sarcoma de Ewing en los huesos planos es en particular difícil de identificar específicamente.

La comprensión de la complejidad del diagnóstico diferencial de este tumor debe indicarle cautela al radiólogo, pero al mismo tiempo ponerlo más sobre aviso en cuanto a la ocurrencia de esta enfermedad mortífera en circunstancias en que antes no hubiera parecido probable tal posibilidad.

Recurrent Carcinoma of the Colon at the Site of the Anastomosis

Roentgen Observations[1]

FELIX G. FLEISCHNER, M.D., and ARNOLD L. BERENBERG, M.D.

THE OCCURRENCE of multiple malignant tumors has always attracted the interest of pathologists and clinicians. The problem consists in determining whether the development of a second growth is entirely independent of the first, unrelated either to metastasis or to recurrence following incomplete eradication. In the case of carcinoma of the colon, a particular type of local recurrence has recently been observed. As pointed out by Cole (1), such a carcinoma, even after ample resection, may recur at the site of anastomosis. Goligher, Dukes, and Bussey (2) have also been impressed with the frequent recurrence of carcinoma—particularly carcinoma of the sigmoid and, to a lesser degree, of the descending colon—at the site of the end-to-end anastomosis. Since we have been unable to find any discussion of this problem as it concerns the roentgenologist, our observations are presented.

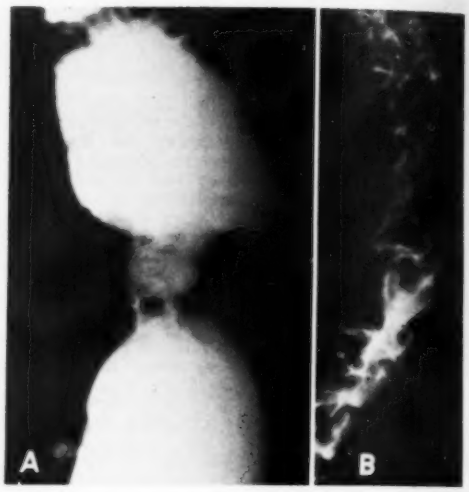


Fig. I. Case 1. Recurrent annular carcinoma in the mid descending colon at the site of the primary end-to-end anastomosis. A. Colon filled. B. After defecation.

CASE I: S. G., a 68-year-old woman, had a constricting annular mucoid adenocarcinoma of the mid-portion of the descending colon, which was resected in 1949 with sleeves of healthy colon, 17 cm. proximal and 5 cm. distal to the lesion. On a routine re-examination in 1950, small irregularities at the site of the end-to-end anastomosis were noticed. These became more pronounced in 1951 and still more so in 1952. Because of the original resection of a wide portion of healthy tissue and the complete freedom from symptoms, the changes were for a long time considered to be due to the surgical intervention. A local recurrence was suspected only when more irregularity and an annular stricture were observed at an examination three years after the operation (Fig. 1). A penetrating colloid adenocarcinoma at the site of the anastomosis was successfully removed on Jan. 11, 1953.

CASE II: N. S., a 70-year-old woman, was examined because of massive rectal bleeding. A lobulated pedunculated lesion 2.5 cm. in diameter with a stalk 4 cm. in length was discovered in the mid-sigmoid (Fig. 2A). At operation, Oct. 4, 1950, a segment of the sigmoid, including 5 cm. on either side of the insertion of the polyp, was resected and an end-to-end anastomosis performed. Grossly, the lesion was a pedunculated polyp but histologically the lobulated head was found to be a colloid adenocarcinoma, which did not invade the stalk. Several benign polyps were removed from the rectum. The patient was again seen for rectal bleeding in January 1953. Roentgen examination now revealed an annular, moderately constricting lesion in the mid-sigmoid, apparently about the site of the anastomosis (Fig. 2B). On Jan. 23, another sleeve resection of the sigmoid was performed. The pathologist described the lesion as an adenocarcinoma, recurrent at the site of the earlier anastomosis and spreading to the serosa (Fig. 3).

CASE III: J. S., a 70-year-old woman, underwent a resection of the sigmoid for an annular carcinoma in July 1952. A recurrence was observed in December 1952, less than six months postoperatively.

CASE IV: C. G., a 59-year-old woman, had a partial resection of the transverse colon for obstructing adenocarcinoma in May 1953. Suspicious irregularities at the site of the anastomosis were first

[1] From the Department of Radiology, Beth Israel Hospital and Harvard Medical School, Boston, Mass. Delivered before the Eastern Conference of Radiologists, Boston, March 4, 1955. Accepted for publication in April 1955.

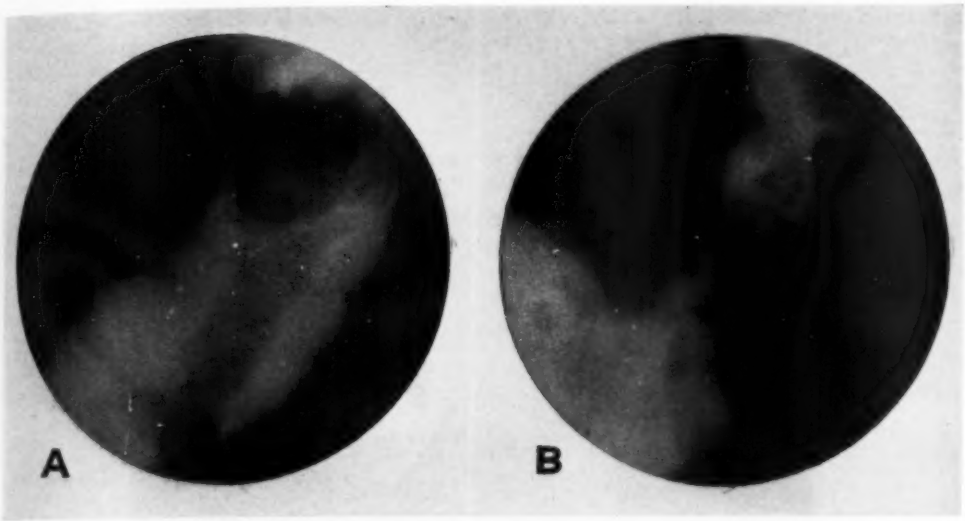


Fig. 2. Case II. A. Polypoid carcinoma of the sigmoid, resected Oct. 4, 1950. B. Recurrent annular carcinoma at the site of the anastomosis, January 1953.

noticed in December 1953, and by May 1954 definite evidence of a lesion was present. A second resection was performed, and in December 1954 another recurrence was identified. Operation was again performed in January 1955, and suture material was found in the center of a carcinoma, surrounded by foreign body granuloma (Dr. Gherardi).

CASE V: E. S. An adenocarcinoma in the distal transverse colon was resected in April 1951. Eight months later a disk-like tumor was found at the site of the anastomosis, with black suture threads in its center.

The following 2 cases were diagnosed by the pathologists as papillomas. While we are aware of the difference of opinion concerning such classification, we are including the cases in this series because of the similarity of the clinical and roentgenologic behavior to that of undisputed carcinomas.

CASE VI: A. W., a 70-year-old man, was found to have a bleeding polypoid tumor with a broad stalk in the mid-sigmoid. No other polyp could be discovered on sigmoidoscopic or roentgen examination. At operation, Feb. 17, 1950, the lesion was removed, with 5 cm. of healthy sigmoid on either side. The pathologic diagnosis was papilloma of the sigmoid. Two months later, gross irregularity of the bowel contour and narrowing at the site of the anastomosis were observed. After another two months the changes were seen to be less pronounced (Fig. 4A), and ten months after the operation the

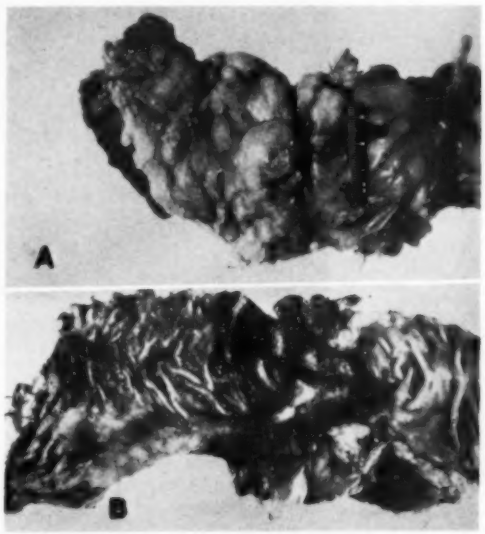


Fig. 3. Case II. Surgical specimen of the second resection. A. From the serosal side, showing the groove of the anastomosis. B. The opened bowel seen from the inner side. The lobulated ulcerated tumor masses are clearly visible.

lumen of the sigmoid showed an even caliber and a circular fold apparently marking the line of the mucosal suture. A well defined central filling defect 1.0 × 1.5 cm. was present, however, at the site of the anastomosis. This filling defect was again demonstrated eleven months later, without definite change in size or shape (Fig. 4B). With the oc-

currence of rectal bleeding and enlargement and lobulation of the visible mass, a recurrent tumor was seriously suspected (Fig. 4, C and D). This was removed at re-operation (September 1952), along with a section of colon 5 cm. proximal and 2 cm. distal to the lesion, and end-to-end anastomosis was done. A sessile papilloma found in the suture line was reported by the pathologist to be of the same histologic structure as the original tumor.

The patient was next seen in February 1954 because of rectal bleeding, and roentgen examination again revealed a polypoid lesion, 1.0 × 1.5 cm., at the site of the anastomosis (Fig. 5). This was resected and again a papilloma in the suture line was found; this recurrence was discovered forty-four months after the first operation and seventeen months after the second.

CASE VII: A. G., a 61-year-old man, underwent resection for an adenocarcinoma and several small polyps in the sigmoid in 1940. He had two recurrences; the second was identified as papilloma at the site of anastomosis.

CASE VIII: S. J., a woman aged 56, had an encircling adenocarcinoma of the upper sigmoid which was resected in May 1947. A local recurrence was resected in 1948, and a second in April 1949. At death, nine months later, a small nodular mucoid carcinoma was found at the site of the anastomosis. The first recurrence followed removal of the original tumor by ten months, the second by twenty-three months, and the third by thirty-two months

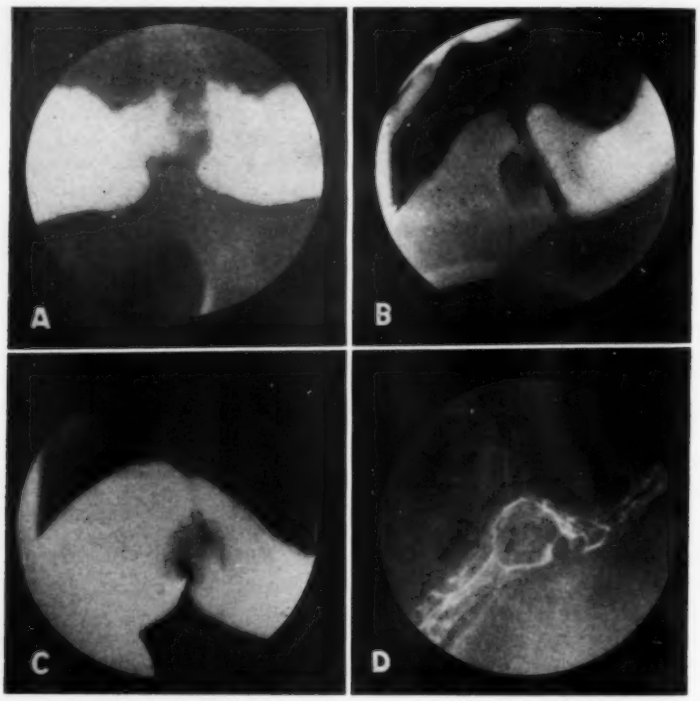


Fig. 4. Case VI. A. Four months after operation; probably inflammatory swelling. B. Ten months after operation: suture line and small nodular lesion. C and D. Thirty-one months after operation; irregular polypoid tumor visible on the roentgenograms of the barium-filled and post-evacuation colon.

CASE IX: C. B., a 74-year-old woman with an adenocarcinoma of the cecum, underwent resection of 12 cm. of the ileum and the right colon with end-to-end ileo-transverse colostomy on April 14, 1954. On re-examination by barium enema four months later, a small irregularity was discovered at what appeared to be the ileal side of the anastomosis. Slight anemia developed, and one month later (Oct. 9, 1954) a distinct filling defect was found (Fig. 6). The ileocolostomy was resected six months after the first operation, and an adenocarcinoma with suture threads at its center was found at the site.

CASE X: A. G., a 48-year-old man had an encircling adenocarcinoma of the right transverse colon. Twelve months following its resection and end-to-end ileo-transverse colostomy, a local recurrence was found at the site of the anastomosis.

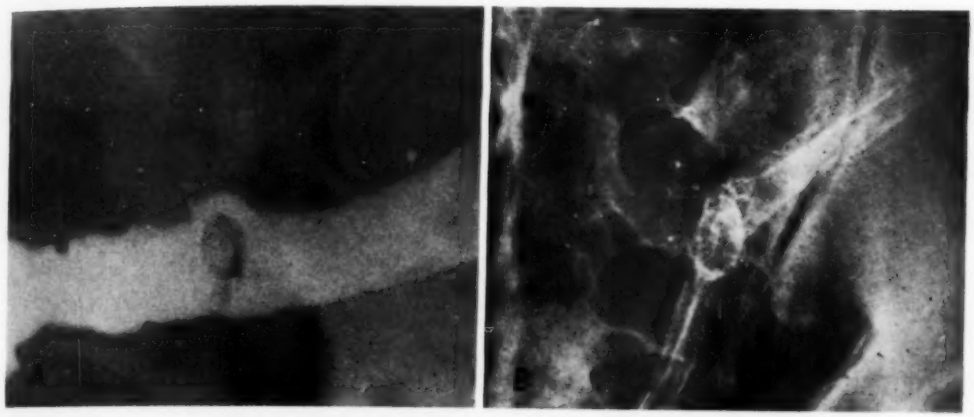


Fig. 5. Case VI. Seventeen months after re-operation a new polypoid lesion has developed at the site of the anastomosis. In A the tumor is seen to straddle the suture line. Films obtained with colon full (A) and after defecation (B).

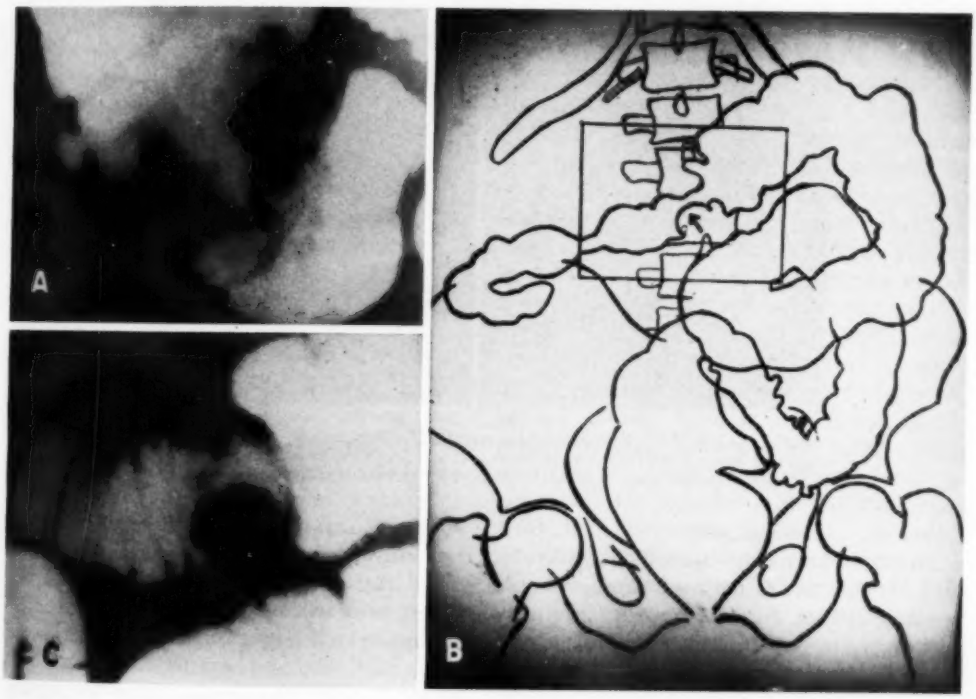


Fig. 6. Case IX. A. Annular carcinoma of the cecum. B. Recurrent tumor six months later, on the ileal side of the end-to-end anastomosis (tracing of film). The rectangle with arrow indicating the tumor is reproduced as C.

CASE XI: P. B., a 42-year-old man, had a bleeding broad-based polypoid adenocarcinoma of the mid-sigmoid, which was resected, with an end-to-end anastomosis. There were postoperative complications, and roentgen examination one month after operation showed a short sinus tract originating from the site of the anastomosis. Irregularities of the contour and mucosal relief in this portion of the sigmoid were also observed (Fig. 7, A and B). The patient recovered without further surgical intervention.

One year later, a well defined, almost spherical

filling defect was demonstrated roentgenologically at the site of the anastomosis (Fig. 7,C and D). In view of the past history and the roentgen-recorded local inflammatory changes, it seemed safe to interpret these changes as representing a cicatricial deformity, rather than recurrent tumor. This finding was confirmed by the absence of change more than two years after operation.

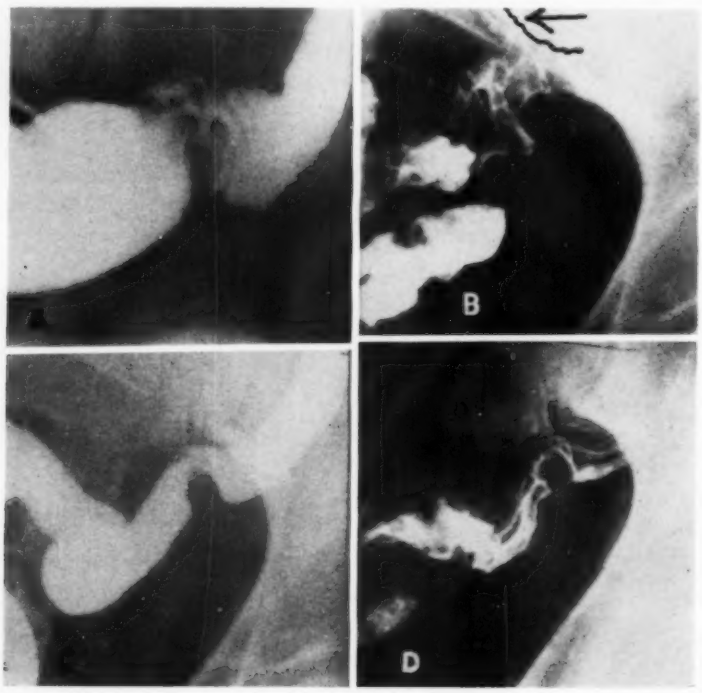


Fig. 7. Case XI. A and B. One month after operation: irregular narrowing and a short sinus tract (retouched). C and D. One year later: smooth indentation showing some similarity to the postoperative picture.

DISCUSSION

The rule stated by Billroth in 1868 (3), that multiplicity of primary tumors should be established by differences in histopathologic appearance, was sufficient and valid, particularly in ruling out the metastatic nature of tumors occurring in different organs. This definition is too narrow, however, to cover tumors which develop in the same organ. The definition given by Warren and Gates in 1932 (4) is considered more applicable to our present problem. Their criteria are as follows: Each of the tumors must present a definite picture of malignancy; each must be distinct; the probability of one being a metastasis of the other should be excluded.

With the performance of more extensive surgery, multiple tumors of the colon have been found in increasing number. Multiple *simultaneous* tumors have been recognized more frequently in recent years by roentgen examination. For example, when one tumor is established by sigmoidoscopy, the complete roentgen survey of the colon may reveal one or two additional lesions, which might or might not be found otherwise during the surgical eradication of the original tumor. The increasing frequency of observation of multiple *nonsimultaneous* tumors may be attributed in part to successful treatment of the first lesion in patients with a constitutional tendency to carcinoma. In a patient, for example, with multiple polyps of the colon, the removal of one tumor furnishes an opportunity for the development of

malignant change in remaining precancerous lesions.

Recurrent carcinoma at the site of an anastomosis is of particular significance for several reasons. In previous discussions of recurrence the following pathogenic possibilities were usually considered: (*a*) continuous growth of cancer tissue inadvertently left behind by the surgeon, *i.e.*, a part of the parent tumor; (*b*) malignant degeneration of a neighboring polyp; (*c*) development of fresh carcinomatous changes from predisposed epithelium in the neighborhood of the original tumor (5–8).

Though modest in number, the present series of recurrent carcinomas of the colon observed during two years in current material, augmented by a few examples from colleagues, tends to corroborate Cole's concept of a distinct pathological process, *i.e.*, implant metastasis, a mode of recurrence not considered in earlier discussions of this subject. It is important for the roentgenologist to be aware of the rather high incidence of this phenomenon—10 per cent according to Cole's observation and 50 per cent according to Goligher—regardless of the validity of the suggested pathogenesis and the preventive technical measures recommended by Cole.

Case I illustrates this point. On reexamination after resection of a carcinoma of the descending colon and end-to-end anastomosis, an irregularity was found at the site of the anastomosis. Since the patient was entirely free of symptoms and long healthy portions of the bowel on either side of the carcinoma had been resected, the significance of this irregularity was minimized and it was interpreted as being caused by the particular type of suturing. Particularly was this so since we had no knowledge, at that time, of the occurrence and theory of implant metastases. Only when the irregularities at the site of the anastomosis changed in appearance and increased in size in the course of several months was a local recurrence seriously suspected.

In Cases IX and X, both instances of local recurrence at the site of ileocolostomy, recurrent tumor was found to center on the ileal side of the stoma, so far as could be ascertained from the roentgen appearance and the pathological findings. While it is almost impossible in any recurrent growth in the colon to exclude the possibility of a pre-existent carcinomatous or precancerous lesion at that site, the location of the tumor on the ileal side greatly supports the concept of tumor fragment implantation during cutting and suturing. The finding of suture threads in the center of the recurrent carcinoma in 3 cases (IV, V, and VIII) adds further weight to this view.

Sharpe and Golden (9), in their roentgenologic studies on end-to-end anastomosis of the colon, found constrictions caused by inverted sutures, granuloma, spasm, and edema in most patients (93 per cent) examined during the first postoperative year. These changes became less frequent after a longer interval. In most instances, the constrictions were bilateral or circular. Among their 42 cases, unilateral constriction was present in only 4; in 3 of these, this was associated with a recurrent carcinoma.

Our observations show that postoperative constriction due to artefacts, edema, or spasm is usually circular, causing bilateral filling defects, while the locally recurrent carcinoma is often more limited in extent, producing a unilateral defect, as described by Sharpe and Golden. This statistical distinction, however, has only a relative probability value; it is not reliable in the differential diagnosis of the individual case. A unilateral filling defect may be the result of a postoperative inflammatory complication or due to vagaries of infolded layers, as in Case XI. Moreover, if the recurrent carcinoma is allowed to grow, it is apt eventually to encircle the bowel and cause a bilateral filling defect (Cases I, II, IV, and VII).

The roentgen changes at the site of the operation depend on the surgical technic, on the postoperative course, and on the time elapsed since the operation. We have

seen uncomplicated cases in which a permanent status was reached one to six months after operation. The normal end-to-end anastomosis in the left colon—most commonly the sigmoid—after resection of a carcinoma is hardly recognizable. In other instances, a slight ring-shaped constriction may be seen in the over-filled colon, though there may be no irregularity of contour when the bowel is moderately filled or collapsed. On compression spot films or with the double-contrast method, one may recognize a smooth encircling line at the exact site of the suture of the mucosa, which otherwise shows normal relief. Every irregularity, any mass projecting into the bowel lumen, even the size of a pea, is abnormal and should be recorded as such. Also localized lack of pliability of the wall or gross irregularity of mucosal relief at the site of anastomosis should be considered abnormal. On the other hand, we have included in this report one of several cases in which the fact of non-per-primam healing was incidentally known to us. In these instances, the demonstration of irregularities at the site of the anastomosis soon after the operation, and their constancy at later examinations, indicated their non-malignant nature. Such observations suggest means of avoiding the difficulty presented in other instances where similar irregularities are encountered after one or two years. Examination of the colon and careful roentgenographic recording of the site of the anastomosis a short time after the operation provide an invaluable means for comparison with changes found subsequently.

As a general rule, one or two months after the operation is proposed as a proper time for examination in cases with an uncomplicated postoperative course. If gross irregularities at the site of the anastomosis are encountered, further examination in another two months will probably demonstrate the permanent resting condition of the anastomosis and provide a record of it. In cases with local postoperative complications, no rigid time schedule can be set; repeated examinations will enable one to establish the appearance of distortion caused by the surgical intervention and its sequelae as a base line by which to judge changes observed at a later date.

CONCLUSION AND SUMMARY

Local recurrences of carcinoma are frequently found at the site of anastomosis following resection of a carcinoma of the left colon with end-to-end anastomosis or resection of the right colon with ileo-transverse colostomy. Ten such recurrences are reported following operation at intervals of five months to six years. In 2 instances, a second recurrence was observed and in 1 a third recurrence was identified at autopsy. It is believed that these recurrences are caused by implantation of cancer cells in the suture line at the time of operation.

Since it may be difficult or even impossible to distinguish a significant from an insignificant cicatricial irregularity at the site of anastomosis, at a single examination, it is recommended that in every case of resection of a carcinoma of the colon and anastomosis, a roentgen examination be performed as soon as the operative site is assumed to have reached a permanent condition. In the average case, this is between four and eight weeks. Postoperative complications may delay re-examination; on the other hand, they may and should prompt such a restudy, as leakage and inflammatory changes may be shown at the site of the anastomosis. These changes found again at a later date would not raise the suspicion of recurrent cancer if they were known to have existed immediately after the operation. Thus, observations over a period of time and comparisons with the early postoperative condition are the most reliable methods for early diagnosis of a local recurrence.

Furthermore, in any examination of a colon on which an operation for carcinoma has been performed previously, the site of the anastomosis should be carefully scrutinized and the condition found recorded

by adequate roentgenographic methods, including spot films and routine roentgenograms. Such records as a basis for comparison, when slight changes are found at the site of the anastomosis, may be a determining factor for the health and life of the patient.

ACKNOWLEDGMENT: We wish to thank Drs. Stanley M. Wyman and Claude E. Welch of Massachusetts General Hospital, Drs. Norman Heilbrun and Charles Bernstein of Buffalo, N. Y., and Dr. Merrill C. Sosman of Peter Bent Brigham Hospital, for their friendly contribution of Cases V, VIII, and X, respectively. We are grateful, also, to Dr. Leopold Reiner, acting pathologist of Beth Israel Hospital, for help in collecting, reviewing, and interpreting the pathological material.

ADDENDUM: Since this paper was submitted, we have observed several similar instances, one of which is remarkable in its pathology. An obstructing carcinoma of the sigmoid was resected from a 61-year-old man. After a two-year asymptomatic interval, there was a local recurrence with extensive lymph-node and hepatic metastases, histologically identical with the original tumor.

REFERENCES

1. COLE, W. H.: Recurrence in Carcinoma of the Colon and Proximal Rectum Following Resection for Carcinoma. Arch. Surg. **65**: 264–270, August 1952.
2. GOLIGHER, J. C., DUKES, C. E., AND BUSSEY, H. J. R.: Local Recurrences after Sphincter-Saving Excisions for Carcinoma of the Rectum and Rectosigmoid. Brit. J. Surg. **39**: 199–211, November 1951.
3. BILLROTH: Quoted by Warren and Gates (4).
4. WARREN, S., AND GATES, O.: Multiple Primary Malignant Tumors: Survey of Literature and Statistical Study. Am. J. Cancer **16**: 1358–1414, November 1932.
5. LONG, J. W., MAYO, C. W., DOCKERTY, M. B., AND JUDD, E. S., JR.: Recurrent Versus New and Independent Carcinomas of the Colon and Rectum. Proc. Staff Meet., Mayo Clin. **25**: 169–178, April 12, 1950.
6. THOMAS, J. F., DOCKERTY, M. B., AND WAUGH, J. M.: Multiple Primary Carcinomas of Large Intestine. Cancer **1**: 564–573, November 1948.
7. DUNPHY, J. E.: Recurrent Cancer of the Colon and Rectum. Report of Cases with Favorable Results Following Radical Surgery. New England J. Med. **237**: 111–113, July 24, 1947.
8. TONDREAU, R. L.: Multiple Primary Carcinomas of the Large Intestine. Am. J. Roentgenol. **71**: 794–806, May 1954.
9. SHARPE, M., AND GOLDEN, R.: End-to-End Anastomosis of the Colon Following Resection. A Roentgen Study of Forty-two Cases. Am. J. Roentgenol. **64**: 769–777, November 1950.

Department of Radiology
Beth Israel Hospital
Boston 15, Mass.

SUMARIO

Carcinoma Recurrente del Colon en el Sitio de la Anastomosis

Obsérvanse frecuentemente recurrencias locales del carcinoma en el sitio de la anastomosis, consecutivamente a la resección de un carcinoma de la porción izquierda del colon con anastomosis término-terminal o a la resección de la porción derecha del colon con colostomía íleo-transversal. Preséntanse diez de esas recurrencias observadas a plazos de cinco meses a seis años después de la operación. En 2 casos, se observó una segunda recurrencia y en uno se identificó una tercera recurrencia en la autopsia. Parece que esas recurrencias se deben al implante de células cancerosas en la línea de sutura al operar.

Como puede resultar difícil y hasta imposible diferenciar, en un solo examen, una irregularidad cicatricial importante de una insignificante en el sitio de la anastomosis, recomiéndase que, en todo caso de resección de carcinoma del colon y anastomosis, se verifique un examen roentgenológico apenas el sitio operado alcance estado permanente. En la mayoría de los casos, esto se toma de cuatro a ocho semanas. Las complicaciones postoperatorias pueden demorar el re-examen; por otro lado, pueden y deben incitar ese nuevo estudio, dado que tal vez se noten escurrimiento y alteraciones inflamatorias en el sitio de la anastomosis. Observadas otra vez más tarde, esas alteraciones no despertarían la sospecha de recurrencia del cáncer si se supiera que ya existían inmediatamente después de la operación.

Además, en todo examen de un colon en que se haya ejecutado antes una intervención por carcinoma, hay que estudiar cuidadosamente el sitio de la anastomosis y que registrar la situación existente con técnicas roentgenográficas adecuadas, incluso radiografícas instantáneas.

The Gas or Vacuum Phenomenon in the Pubic Symphysis During Pregnancy[1]

MORTIMER R. CAMIEL, M.D., and JULES B. AARON, M.D.

THE PUBIC symphysis, altered by the physiologic and hormonal influences of pregnancy, exhibits changes which are only now beginning to be understood. Among the changes incidental to relaxation and widening is the appearance within this articulation of a roentgen shadow of gas or vacuum density. This phenomenon, commonly overlooked or misinterpreted, has only recently become the subject of discussion.

Each opposing surface of the pubic bone is covered by a thin layer of hyaline cartilage joined to the bone by a series of nipple-like processes (7, 8). The facing surfaces are connected with each other by fibrocartilage of varying thickness, often containing a longitudinal cavity or cleft, unlined by synovial membrane. It is said to be this potential space, ordinarily invisible on a roentgenogram, which under the influence of pregnancy becomes visible as the shadow described above.

HISTORY

Utilizing an intravaginal film applicator, Dale (3), in 1930, studied the pubic symphysis of pregnant women and noted varying degrees of widening. In non-pregnant women and those who had been pregnant some time previously, the average joint width was 4 mm. In 35 women, pregnant but not complaining of pubic pain, the average width was 6 mm. In 19 patients complaining of discomfort, the average width was 7 to 8 mm. Nearly all of this last group showed a fissure centrally located in the pubic articulation. Magnusson (12), in 1937, observed the gas or vacuum phenomenon in the pubic articulation and other joints but did not believe that any practical importance could be attached to it.

Williams (17), in an excellent and definitive investigation, studied 3,000 roentgen pelvimetry films and found the phenomenon to be common. In a specific analysis of 232 roentgen pelvimetric studies done near term, the incidence of "gas" streaks in the symphysis was 41.5 per cent. No correlation was observed between pain in the symphysis and the presence or absence of "gas." In most cases the gas disappeared within one week following delivery, although in 2 cases it could still be seen twenty days later.

MATERIAL AND FINDINGS

We have observed this gas shadow for some time and it was therefore decided to check our findings on a sample of 100 cases. The films were taken consecutively, and completely at random, from a drawer which contained pelvimetric studies, unfiled according to any pattern. They were unselected except that they represented examinations of women near term who had been studied for the usual obstetrical indications.

A clear and unmistakable dark streak running vertically near the center of the pubic articulation was interpreted as positive (Fig. 1). All doubtful shadows, including probable ones, were called negative. Even with these rigid criteria, 30 of the 100 cases showed this phenomenon. There was no notable difference between primiparae and multiparae. The size or shape of the pelvis did not play a significant role. There was no relationship to pubic pain, which is an uncommon complaint.

In an effort to determine whether pressure from the head influenced the appearance of the shadow, 22 breech cases were studied. Six (31.3 per cent) were positive, giving almost the same percentage as cephalic presentations.

Roentgenographically, the articular gas

[1] Accepted for publication in April, 1955.

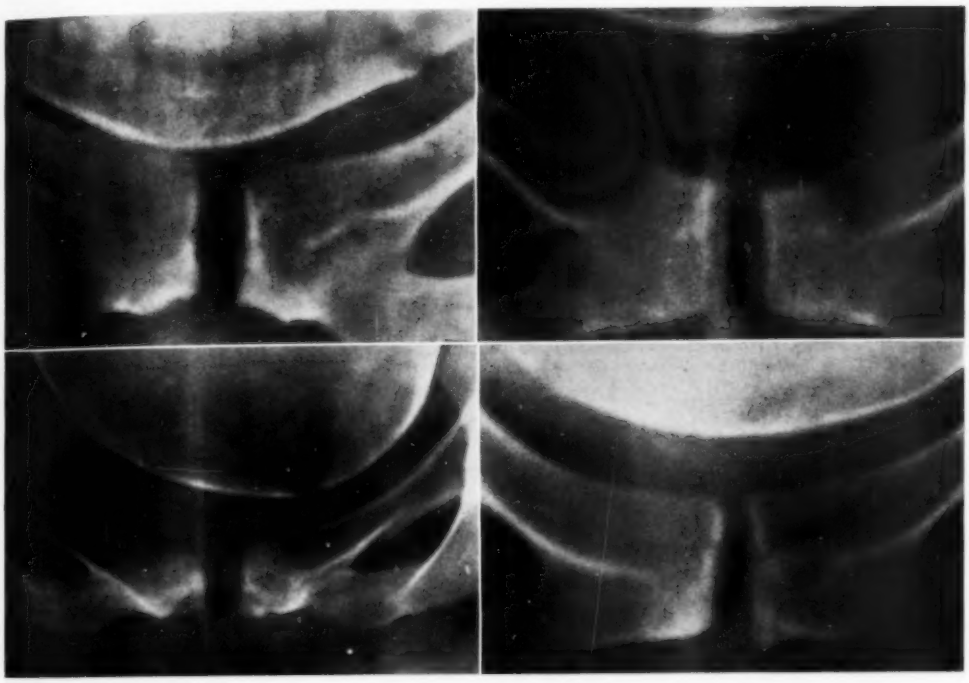


Fig. 1. Examples of the gas or vacuum phenomenon in the symphysis pubis late in pregnancy.

shadow is seen as a dense vertical streak, of roughly linear, oval, or wedge shape, lying near the center of a somewhat widened pubic articulation. In 9 of the 30 positive cases, multiple streaks were seen (Fig. 2); 8 of these were double and 1 was triple. Many of the secondary shadows lay near the bone surface, suggesting a tear away from the cortex. With the patient on her back, the joint spreads, permitting easier visualization. In the prone position the joint surfaces are more compressed, resulting in a thinner line of visibility. A rare case actually showed small bony particles at the joint, apparently torn away from the surface (Fig. 3). While most of the fissures were roughly central, their inconstant and irregular contours suggested a possibly traumatic component rather than a true joint space. Air within the buttock fold and gas in the bowel should not be mistaken for this finding. Its characteristic location within the pubic articulation makes its identification unmistakable.

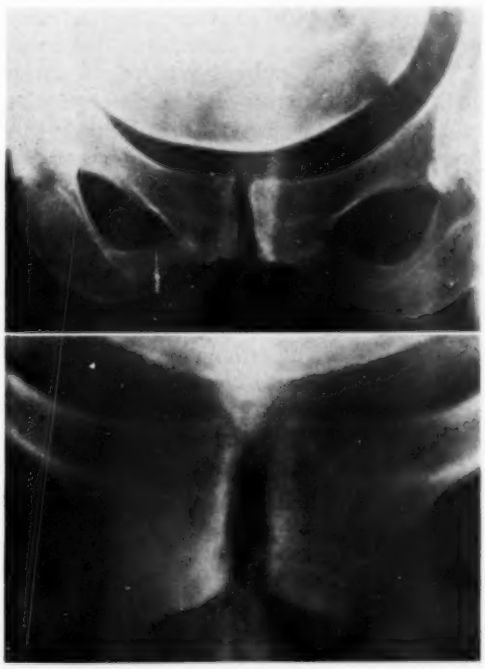


Fig. 2. Multiple fissures suggesting a traumatic factor.

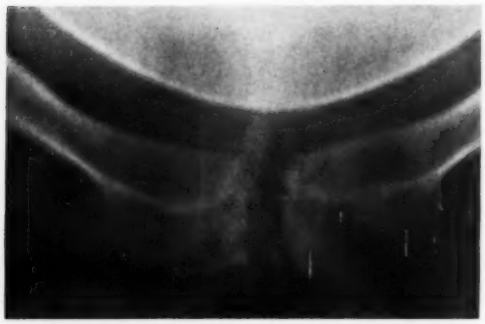


Fig. 3. Small bony particles visible at the symphysis, suggesting trauma.

DISCUSSION

It is to be recalled that the central pubic fissure described by the anatomists is not lined by synovial membrane. The origin of this space is obscure. It does not appear until about the ninth year of life. It is thought to be due to vascular degeneration secondary to weight-bearing and walking (2). While most of the fissures demonstrated in our series were approximately central, their inconstant pattern and contour, as pointed out above, suggested a superimposed traumatic or degenerative component.

Normally, the pubic symphysis is resistant to separation. Relaxation of the pelvic joints, however, begins early in pregnancy and increases notably during the last trimester (1). Hoffman (10) describes a widening, thickening, softening, and increased vascularization in and about the pubic joint. The tissues imbibe fluid and the capsule thickens. The pubic, sacrococcygeal, and sacroiliac joints are affected in the order named.

Joint spaces are actually only potential spaces, since they are filled with fluid and other contents. Such a potential space obviously cannot be seen roentgenologically. Occasionally, however, these spaces are made real by traction, trauma, relaxation, unusual tensions, disease, or degenerative changes, under atmospheric pressure, and even with awkward positioning. In such instances they appear on the roentgenogram as dense black shadows outlining that portion of the joint which has become a true space. With the formation of such a space it is assumed that a vacuum, or at least a negative pressure balance, is created and gases are sucked into or liberated from the joint fluid, tissues, or blood. While there are no obvious physiologic counterparts recalling an instantaneous release of gases from body tissues into a vacuum, it has been stated that the gas content of joints at high altitudes coincides with the amounts of nitrogen, oxygen, and carbon dioxide normally found in the blood (15). One of us, in positioning infants for hip studies with the thighs forcibly abducted, has frequently observed this gas or vacuum line at the hip joint. These have appeared or disappeared almost instantaneously with changes in forcible leverage. To assume that gases were actually sucked into the joint would be to assume an unlikely type of joint "breathing." In any case, whether the space be a vacuum or filled with gas, its shadow on the roentgen film will be black and readily identifiable.

The recent literature has reflected an increasing awareness of this phenomenon. It has been described in the spine, knee, hips, shoulders, wrists and other joints (4, 5, 6, 11, 13, 14). Where it has not been seen, its presence has been predicted (16). It is therefore no surprise to find it at the symphysis pubis, but its high incidence was unexpected. It is possibly related to the implications of endocrine activity.

That the major influence on the joint is hormonal rather than mechanical is indicated by Williams' detection of the fissure shadow early in pregnancy, long before any pressure from the enlarging uterus could be suspected of prying the joint apart (17). Indeed, he identified the cleft even before fetal parts could be seen. In this event, it could find usefulness as a confirmatory roentgen sign of pregnancy. If mechanical pressure played an important role, one might expect this phenomenon to be seen more frequently in cephalic than in breech presentations. In our separately

studied breech series the incidence was essentially the same as in the cephalic cases. The salutary effect of pregnancy on some types of arthritis is well known. This relaxation phenomenon probably reflects the same hormonal influences.

The patients in our series in whom the gas or vacuum phenomenon in the pubic symphysis was demonstrated had no notable symptoms referable to the pubis. While the relaxation of the pelvic joints undoubtedly played a role in delivery and may conceivably have been a determining influence in some cases of borderline contraction, the presence or absence of the joint shadow itself had no demonstrable association with the outcome of labor. Whether the high incidence of fissure demonstrability represents a normal physiologic pattern or a frequent though minor complication of pregnancy is still undecided. Our findings suggest that the fissures may be due, at least in part, to tears and gaps in the fibrocartilage, possibly antedating the pregnancy or appearing concurrently with it.

SUMMARY AND CONCLUSIONS

Of 100 pubic symphyses examined roentgenologically late in pregnancy, 30 showed a demonstrable cleft or clefts represented by a gas or vacuum shadow.

This phenomenon is a frequent but not troublesome concomitant of the pelvic relaxation incident to pregnancy, but whether it represents a physiologic or a pathologic mechanism is undetermined. The possibility of a traumatic factor is suggested.

It appears that the major influence on the joint is hormonal rather than mechanical, as the fissure shadow has been reported early in the course of pregnancy and its incidence is as high in breech as in cephalic presentations. It bears no demonstrable relation to the outcome of labor.

NOTE: Thanks are expressed to Lilla Atkin, for the roentgenography. The photographic reproductions are by Bergman Associates.

149 New York Ave.
Brooklyn 16, N. Y.

REFERENCES

1. ABRAMSON, D., ROBERTS, S. M., AND WILSON, P. D.: Relaxation of the Pelvic Joints in Pregnancy. Surg., Gynec. & Obst. **58**: 595–613, March 1934.
2. CALLAHAN, J. T.: Separation of the Symphysis Pubis. Am. J. Obst. & Gynec. **66**: 281–293, August 1953.
3. DALE, T.: New Technic of Roentgen Examination of the Symphysis Pubis in Women. Norsk mag. f. laegevidensk **91**: 782–785, July 1930.
4. FUIKS, D. M., AND GRAYSON, C. E.: Vacuum Pneumarthrography and Spontaneous Occurrence of Gas in the Joint Spaces. J. Bone & Joint Surg. **32-A**: 933–938, October 1950.
5. GERSHON-COHEN, J., SCHRAER, H., SKLAROFF, D. M., AND BLUMBERG, N.: Dissolution of the Intervertebral Disk in the Aged Normal. The Phantom Nucleus Pulposus. Radiology **62**: 383–387, March 1954.
6. GERSHON-COHEN, J.: The Phantom Nucleus Pulposus. Am. J. Roentgenol. **56**: 43–48, July 1946.
7. FRANCIS, C. C.: The Human Pelvis. St. Louis, C. V. Mosby Co., 1952, pp. 45–46.
8. GRAY, H.: Anatomy of the Human Body. Philadelphia, Lea & Febiger, 24th Ed., 1942, p. 302.
9. GREENHILL, J. P.: Principles and Practice of Obstetrics. Philadelphia, W. B. Saunders Co., 10th Ed., p. 494.
10. HOFFMAN, J.: Female Endocrinology Including Sections on the Male. Philadelphia, W. B. Saunders Co., 1944, p. 60.
11. KNUTSSON, F.: Vacuum Phenomenon in Intervertebral Discs. Acta radiol **23**: 173–179, 1942.
12. MAGNUSSON, W.: Über die Bedingungen des Hervortretens der wirklichen Gelenkspalte auf dem Röntgenbilde. Acta radiol. **18**: 733–741, 1937.
13. MARR, J. T.: Gas in Intervertebral Discs. Am. J. Roentgenol. **70**: 804–809, November 1953.
14. RAINES, J. R.: Intervertebral Disc Fissures (Vacuum Intervertebral Disc). Am. J. Roentgenol. **70**: 964–966, December 1953.
15. THOMAS, S. F., AND WILLIAMS, O. L.: High Altitude Joint Pain (Bends). Their Roentgenographic Aspects. Radiology **44**: 259–261, March 1945.
16. WIDMANN, B. P., AND STECHER, W. R.: Roentgenographic Demonstration of the True Articular Space. Radiology **27**: 541–544, November 1936.
17. WILLIAMS, J. L.: Gas in the Symphysis Pubis During and Following Pregnancy. Am. J. Roentgenol. **73**: 403–409, March 1955.

SUMARIO

El Fenómeno del Gas o del Vacío en la Sínfisis Púbica Durante el Embarazo

De 100 sínfisis púbicas examinadas roentgenológicamente en un periodo tardío del embarazo, 30 revelaron una hendidura o hendiduras representadas por una sombra de gas o de vacío. Este fenómeno constituye un concomitante frecuente, pero no

molesto, de la relajación pelviana incidente al embarazo, pero está aun por determinar si representa un mecanismo fisiológico o patológico. Sugiérese la posibilidad de un factor traumático.

Parece que el principal influjo sobre la articulación es de orden hormónico más bien que mecánico, pues se ha descrito la sombra de la fisura ya a principios de la gestación y su incidencia es tan elevada en las presentaciones de nalgas como en las cefálicas. Las enfermas que manifestaban esas sombras de gas o de vacío no tenían síntomas extraños imputables al pubis y el fenómeno no guarda la menor relación demostrable con el resultado del parto.

Unusual Uterine Enlargement Caused by Bleeding Due to Hypofibrinogenemia Associated with Fetal Death

JOHN D. OSMOND, Jr., M.D., and CARL W. ROTTER, M.D.

HYPOFIBRINOGENEMIA as a result of fetal death is an unusual cause of uterine bleeding. Only 9 cases (1–3) have been recorded in the American literature. We are reporting the present case to bring the condition to the attention of radiologists who may have the opportunity to postulate such a diagnosis on the basis of unexplained uterine enlargement accompanying death of the fetus.

CASE REPORT

Mrs. M. M., a 31-year-old white woman, was first seen on Sept. 18, 1953, at the beginning of her fifth month of pregnancy. Five days earlier she had experienced pelvic cramps and a moderate upper respiratory infection. Examination did not reveal any unusual physical findings. The blood pressure was 125/75 mm. of mercury. The patient was in good health and stated that she had felt fetal movement for approximately three weeks. The fundus of the uterus was 1.5 cm. above the level of the umbilicus. Fetal heart sounds were heard, 150 per minute. Laboratory studies showed the blood to be Kline-negative, Type A, Rh positive, with 13 gm. hemoglobin. Urinalyses were normal. Seven and eight years previously the patient had been delivered of normal full-term infants.

The cramps continued intermittently for several days, and when a slight brownish vaginal discharge was noted the patient was admitted to the hospital. Epistaxis had occurred on the day before, and she had also noticed several ecchymoses on the extremities.

On admission, Sept. 27, 1953, the temperature, pulse, and respirations were normal and remained so throughout the hospital stay. The blood pressure was 122/72 mm. of mercury, and did not vary significantly. The patient was immediately placed at strict bedrest and given supportive medication. The following day she appeared very pale but had no particular complaints. Blood studies showed hemoglobin 28 per cent, red blood cells 2,220,000, white blood cells 12,800, and a hematocrit of 12 per cent, although there had been no apparent blood loss. Fetal heart sounds could not be positively heard. Two pints of whole blood were given on Sept. 29, and blood studies on Sept. 30 showed hemoglobin 40 per cent, red blood cells, 2,610,000, white blood cells 12,800, hematocrit 21 per cent, platelets 196,000. The differential count was: 86 per cent polymorphonuclears, 8 per cent lymphocytes, 2 per cent eosinophils, 3 per cent monocytes, and 1 per cent basophils. Morphologically the smear was normal. The blood urea nitrogen was 12 mg. per cent.

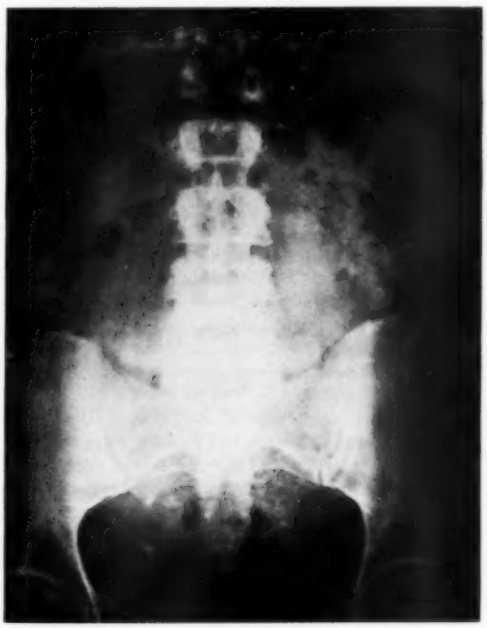


Fig. 1. Anteroposterior roentgenogram of abdomen demonstrating enlarged uterine shadow. The fetus is in a horizontal position, overlying the lower sacrum.

A roentgenogram of the abdomen and pelvis (Fig. 1) obtained on Sept. 30 demonstrated a single fetus in the lower portion of an enlarged uterus. The fetus appeared to be of about four months gestation and the attitude was strongly suggestive of fetal death. The fundus of the uterus, however, was at the unusually high level of the second lumbar vertebra. This enlargement was symmetrical, and no unusual calcification was seen.

A blood count on Oct. 1 was essentially the same as on the previous day. Bleeding and clotting times were normal. Two more units of blood were ad-

[1] From the Departments of Radiology and Obstetrics & Gynecology of the Euclid-Glenville Hospital and the Department of Radiology of the School of Medicine of Western Reserve University. Accepted for publication in January 1955.

ministered. A quantitative Aschheim-Zondek test was within limits for normal pregnancy, thus eliminating hydatidiform mole as a cause for the "tumor" seen on the roentgenogram.

Because of the severe anemia, consultants[2] were requested to see the patient. They suspected death of the fetus, with a large mass of blood in the uterus and postulated hypofibrinogenemia associated with fetal death or with premature separation of the placenta. Fibrinogen determination was obscured by the four units of blood administered in the previous three days, but it was felt that the beneficial effect of the transfusions would soon disappear and that bleeding would recur. It was recommended that, if a decrease in fibrinogen could be demonstrated at any time, the patient should be prepared by administering blood transfusions and fibrinogen prior to emptying the uterus.

As had been anticipated, profuse painless bleeding from the vagina occurred on Oct. 10. After intravenous administration of 1 gm. of fibrinogen, a low Beck-type section was performed and a dead fetus of four and one-half months gestation, with evidence of maceration, was delivered. Following delivery, large amounts of dark liquid blood and clots, estimated at about 4 to 5 pints, were removed from the uterine cavity. Owing to the presence of a placenta accreta, a Porro section was performed. During the operation two pints of blood were given. The patient tolerated the procedure well and left the operating room in good condition. Her convalescence was uneventful and she was discharged from the hospital on the seventh postoperative day. She was examined six months after the operation and found to be in good health.

DISCUSSION

This case illustrates an unusual cause of uterine enlargement. It was difficult to realize that the uterus could be distended so greatly by hemorrhage. Recent reports by Reid, Weiner, Roby, and Diamond and others have revealed that acquired hypofibrinogenemia (or afibrinogenemia) in pregnancy may be seen under at least three circumstances: long-standing retention of a dead fetus *in utero* (1–3), amniotic fluid infusion (embolism, 4), and severe premature separation of the placenta (1, 5).

All of the 9 previously recorded cases occurred in Rh negative patients, and fetal death was due to blood incompatibility. In 1 patient hypofibrinogenemia developed prior to labor, while others were about to enter labor when the defect in the coagulation mechanism was noted. Neither clinical nor pathologic evidence of premature separation of the placenta was demonstrated in these patients.

In the case reported above, it was noted that the patient was Rh positive and, therefore, some other cause of fetal death must be postulated. In the opinion of the surgeon there had not been separation of the placenta to a sufficient degree to cause the intrauterine bleeding. In fact, as stated above, a placenta accreta was present.

The important hematological change occurring in the cases of this nature is a defibrination of blood. Present evidence favors the belief that the hypofibrinogenemia is the result of increased utilization or destruction of fibrinogen rather than a diminution in its production. Depletion of this substance is assumed to be the result of intravascular coagulation caused by escape of a coagulant, possibly thromboplastin, from the uterus into the maternal circulation. The defibrinating material is supposedly derived from autolysis of decidua or placental tissue.

An acquired hypofibrinogenemia is a potential hazard for any patient with retention of a fetus following death *in utero*. Such patients should be carefully observed and periodic examination of the blood by the clot observation test performed until delivery has been accomplished. Labor should not be induced, but abdominal delivery by laparotrachelotomy may be necessary.

DIAGNOSIS

A diagnosis of hypofibrinogenemia may be made definitely upon obtaining a low fibrinogen level or may be presumed, as in 3 of 6 cases reported by Reid *et al.* (3), in a patient retaining a dead fetus and showing hemorrhagic tendencies. The latter are manifested by ecchymoses and bleeding from the uterus and venipuncture sites, as well as from mucous membranes of the respiratory and gastrointestinal tracts. Fibrinogen levels rise to 400 mg./100 c.c., with an average of 300 mg., during pregnancy. A suspected hypofibrinogenemia

[2] Dr. Oscar D. Ratnoff and Dr. Austin Weisberger, University Hospitals, Cleveland, Ohio.

can be confirmed by a simple qualitative test which is performed rapidly in the delivery room. This may be supplemented by a quantitative procedure in the hospital laboratory. It should be added that an abnormally low sedimentation rate is indicative of a hypofibrinogenemia. If the condition is found to be present by any of the above described tests, treatment consists of giving 4 gm. of commercial fibrinogen[3] intravenously. This dosage may have to be repeated.

SUMMARY

An unusual case of uterine enlargement as a result of hemorrhage secondary to hyperfibrinogenemia associated with retention of a dead fetus is presented. A review of recent reports by Reid *et al.* on the etiologic theories of the abnormally low fibrinogen levels, is included.

10515 Carnegie Ave.
Cleveland 6, Ohio

[3] Cutter Laboratories, Berkeley, Calif., is one source.

REFERENCES

1. HODGKINSON, C. P., MARGULIS, R. R., AND LUZADRE, J. H.: Etiology and Management of Hypofibrinogenemia of Pregnancy. J.A.M.A. **154:** 557–561, Feb. 13, 1954.

2. RATNOFF, O. D., LAUSTER, C. F., SHOLL, J. G., AND SCHILLING, M. O.: A Hemorrhagic State During Pregnancy with Presence of Maternal Rh Antibodies, Death of Fetus and Hypofibrinogenemia. Am. J. Med. **13:** 111–120, July 1952.

3. REID, D. E., WEINER, A. E., ROBY, C. C., AND DIAMOND, L. K.: Maternal Afibrinogenemia Associated with Long-standing Intrauterine Fetal Death. Am. J. Obst. & Gynec. **66:** 500–506, September 1953.

4. REID, D. E., WEINER, A. E., AND ROBY, C. C.: Intravascular Clotting and Afibrinogenemia; The Presumptive Lethal Factors in the Syndrome of Amniotic Fluid Embolism. Am. J. Obst. & Gynec. **66:** 465–474, September 1953.

5. WEINER, A. E., REID, D. E., AND ROBY, C. C.: Incoagulable Blood in Severe Premature Separation of the Placenta: A Method of Management. Am. J. Obst. & Gynec. **66:** 475–498, September 1953.

SUMARIO

Extraña Hipertrofia Uterina Ocasionada por Hemorragia Debida a Hipofibrinogenemia Asociada con Muerte Fetal

Preséntase un caso extraño de metripertrofia causada por hemorragia secundaria a hipofibrinogenemia, asociada con muerte de feto. El examen radiográfico de la enferma, que entraba en su quinto mes de embarazo, reveló un solo feto intrauterino de unos cuatro meses de gestación en la porción inferior de un útero hipertrofiado. Hallábase el mismo en una actitud muy indicativa de muerte fetal, hallazgo este confirmado después al verificar la cesárea.

Puede sobrevenir hipofibrinogenemia en el embarazo en tres circunstancias: retención prolongada de un feto muerto en el útero; introducción de líquido amniótico (embolia); grave separación prematura de la placenta. Apúntase que las bajas cifras de fibrinógeno son consecuencia de la mayor utilización o destrucción del mismo, más bien que de una disminución de la producción; se supone que el agotamiento es efecto de la coagulación intravascular motivada por el escape de un coagulante, posiblemente tromboplastina, del útero a la circulación maternal.

Descríbense las pautas para el diagnóstico y sugiérese el tratamiento con fibrinógeno comercial. En las enfermas con retención fetal, deben ejecutarse exámenes periodicos de la sangre con la prueba de observación del coágulo hasta lograr la expulsión.

Osteopathia Condensans Disseminata[1]

GORDON J. HARMSTON, M.D.,
Logan, Utah

OSTEOPATHIA condensans disseminata, because of the absence of symptoms, has been discovered only incidentally following the general use of roentgen rays for diagnosis. An extensive search of the world literature revealed only 81 cases which seemed to be authentic. The present report brings the total to 86. When this number is compared to the millions of roentgenographic examinations made since 1905, the rarity of the condition is apparent.

The terminology is confused, cases having been reported under the following names: osteopecilia, osteopoikilosis, osteitis condensans generalisata, osteosclerosis fragilitas generalisata, and osteopathia condensans disseminata. This last term, as suggested by Lowrey and Booth (1), seems preferable, since it names the condition in accordance with modern nomenclature on an anatomico-pathologic basis, omitting incorrect implications of inflammatory change, fragility, and generalized distribution of lesions. Osteopecilia and osteopoikilosis, meaning "spotted bone," are descriptive of the roentgenographic picture but are otherwise inadequate and so are better discarded.

What we now know as osteopathia condensans disseminata was first correctly described by Stieda (2) in 1905 as "a circumscribed condensing of the bone in the region of the substantia spongiosa," which on microscopic examination was found to be "composed of compact islands of corpuscles and lamellae in irregular arrangement," while the surrounding bone was normal. Whether the condition is a pathologic entity or is simply an anomaly of bony structure is not yet clear. In view of the lack of symptoms, the latter appears more likely.

The etiology is unknown except for the fact that a familial tendency exists in some series. Šváb (3) reported 3 cases, Wilcox (4) reported 2 cases, and Holly (5) 4 cases, all in family groups. Busch (6) in 1937 described 14 cases in one family and attempted to show that the disorder was transmitted through the male in a dominant manner.

The cases to be presented here occurred in a father (R. R.), 3 daughters (F. K., D. C., and H. R.), and a son (B. R.), all with similar involvement. The wife and brother of R. R. had no lesions. The eight-day-old daughter (R. K.) of F. K. failed to show the changes, but the possibility of their future development cannot be excluded. With this in mind, periodic examinations are planned. The mother and father of R. R. were deceased and information as to their bone status was not available.

Results of a roentgen survey in this series reveal a definite familial and hereditary predilection for osteopathia condensans disseminata, verifying the impressions of Busch, Šváb, Voorhoeve (7), Wilcox, and Holly. In this family group, the lesions were transmitted by the father to his children, which supports the view of Busch as to the mode of inheritance.

None of these patients had disseminated lenticular dermatofibrosis as seen in the 3 cases reported by Windholz (8), 1 by Šváb, 1 by Pokorny and Pokorny (9), and 1 by Buschke and Ollendorff (10). Neither did any of them have diabetes or other diseases, as noted by some authors. Parathyroid disease, typhoid fever, hypopituitarism, tuberculosis, and syphilis have been described in association with osteopathia condensans disseminata, but it appears that the latter condition is only incidentally related to the diseases from which the patient may be suffering at the time the bony lesions are discovered.

Osteopathia condensans disseminata has been observed more often in males than in

[1] Accepted for publication in February 1955.

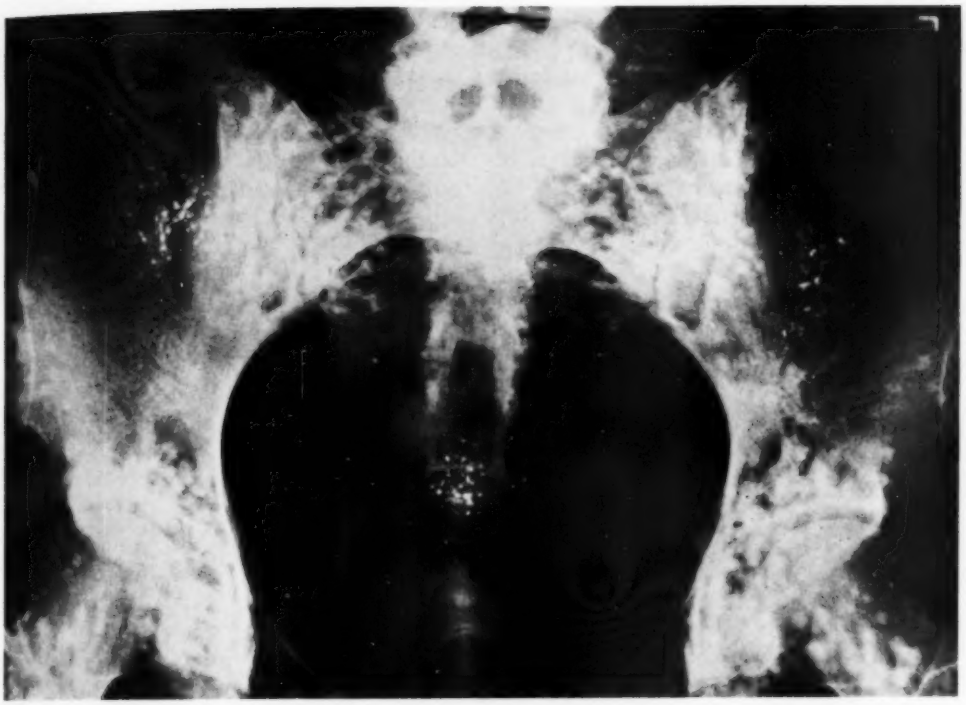


Fig. 1. Anteroposterior roentgenogram of pelvis demonstrating the typical para-articular location of the areas of increased bony density. In all cases the pelvis and the upper femurs were more intensely affected than any other portion of the skeleton.

females, but because of the small number of cases on record, the actual sex ratio is not clear. Of our patients, 2 were males and 3 females. Heilbron claimed to have seen the condition in the bones of a four-months fetus, and Keyser saw an infant only a few days old with the disorder. Since osteopathia condensans disseminata ordinarily is discovered by accident, there is no way of knowing at what age it begins or if, in fact, it is not usually congenital.

Pathologically, in the few cases described, small lens-shaped nodules of homogeneous gray matter, resembling osteomata, are surrounded completely by spongiosa. The lesions are not scattered evenly through the marrow cavity but lie chiefly just below the cortex, leaving the center more or less free. In rare instances the nodules are connected to the cortical bone. Microscopically, they are composed of tightly compressed bony lamellae, radially distributed. At the margin is a dense, roughened capsule with several foramina connecting the scanty marrow of the nodule with the spongiosa. Schmorl (11) noted atrophy of both bone and nodules in his patient, indicating that the latter participate in the general bony metabolism. He stated that cartilage is never found in the nodules and suggests that they develop directly from spongiosa, but Funshteyn and Kotschiew (12) attribute them to disturbed endochondral ossification. The exact cells of origin are not known. Studies of blood and urine calcium, phosphorus, and phosphatase have revealed normal levels.

As previously stated, osteopathia condensans disseminata is without symptoms and so is generally discovered by accident, during x-ray examination for other purposes. A few cases have been found by deliberate roentgen examination of fami-

lies in which the disease was known to occur. Generally, these patients have been found to be robust and without complaints referable to the involved skeleton. In a few instances, pain in the joints adjacent to the areas of infiltration has been reported. The relationship of the pain to the joint lesion is not proved, however, and it is now generally accepted that the disorder tend to be localized at points of stress and motion. The pelvis, femurs, carpal, and tarsal bones are those most commonly involved, but all bones except the sternum have been shown to be affected. Lesions of the skull, ribs, and spine, however, are only rarely reported.

Previous to the publication of Holly's paper in 1936, it was generally believed

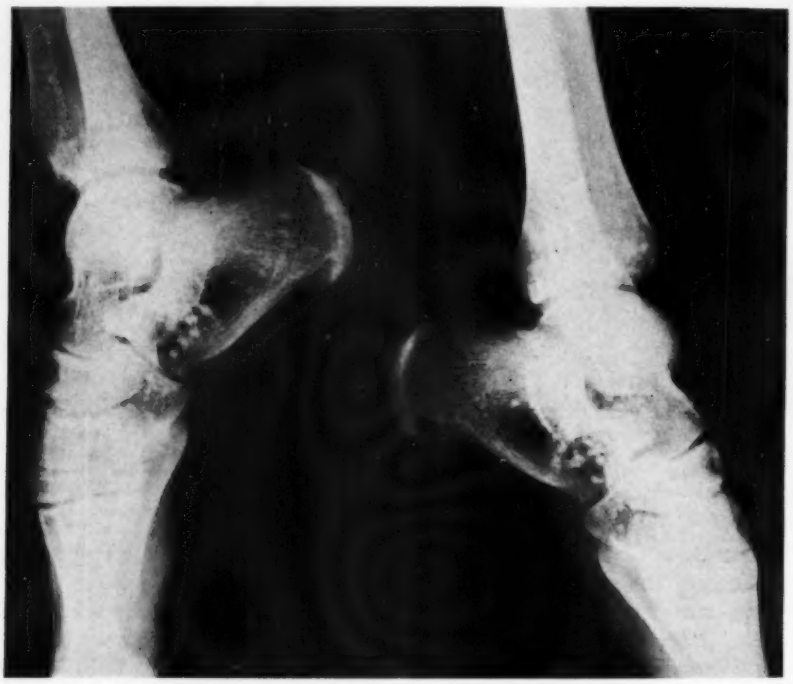


Fig. 2. Lateral roentgenograms of both feet, showing the bilateral, symmetrical distribution of lesions. Note the normal condition of the adjacent bone.

is asymptomatic and without pathologic significance.

Roentgenologically, compact bone is seen lying within the marrow, appearing as rounded, oval, or elongated areas of increased density from 0.2 to 1.0 cm. in diameter, resembling cotton balls. The shape is usually spherical but may be oval, in which case the long axis of the lesion lies parallel to the long axis of the bone or, in the flat bones or epiphyses, runs in the general direction of the trabeculae. The contour and characteristics of the involved bones are otherwise normal. The lesions that the lesions of osteopathia condensans disseminata remained unchanged throughout life. However, in 4 cases which he followed with serial roentgenograms over a period of fifteen years, he obtained definite evidence of change in the islands of tissue. Some enlarged, some disappeared entirely, and others appeared where none existed previously, indicating activity of osteoblasts and osteoclasts. Nichols and Shiflett (13) in 1934 reported a case in a thirty-four-year-old female patient who was followed for seven years, during which no change was noted in the areas of condensa-

tion. Newcomet (14) followed a case for four years without observing any change. It appears, therefore, that the activity of the cells of the bony islands varies from patient to patient and is controlled by unknown factors.

Osteopathia condensans disseminata must be distinguished from osteoblastic metastatic cancer, tuberculosis of the bone, diffuse osteomyelitis, and osteopetrosis. This is usually easily done by clinical study of the patient and x-ray examination of the remaining skeleton.

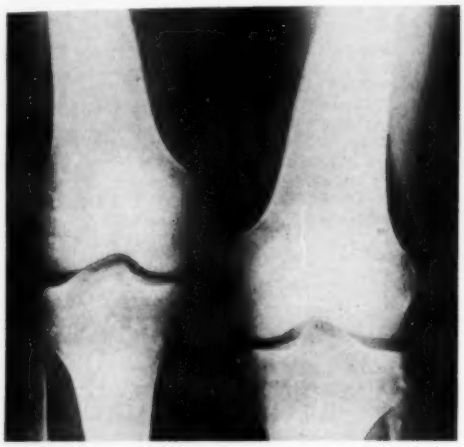


Fig. 3 Anteroposterior roentgenograms of both knees demonstrating the lesions as typically present in all 5 cases. The joint surfaces are entirely normal.

The first patient in the present series was a twenty-two-year-old white female (F. K.),[2] in whom the disorder was discovered at the time of a roentgen examination of the gallbladder. Except for a gallbladder attack one week previously and the birth of a single full-term infant eight days before, the past history was not significant.

At the time of the gallbladder examination lesions were noted in the pelvic bones. This led to full-body x-ray study, which revealed similar changes in all bones but the upper thoracic and cervical spine, ribs, sternum, and skull. In all the involved bones the lesions were bilateral and more or less symmetrical. The posterior portions of the vertebral bodies contained most of the vertebral lesions, as shown by oblique and lateral films.

[2] Patient of Dr. W. E. Cragun.

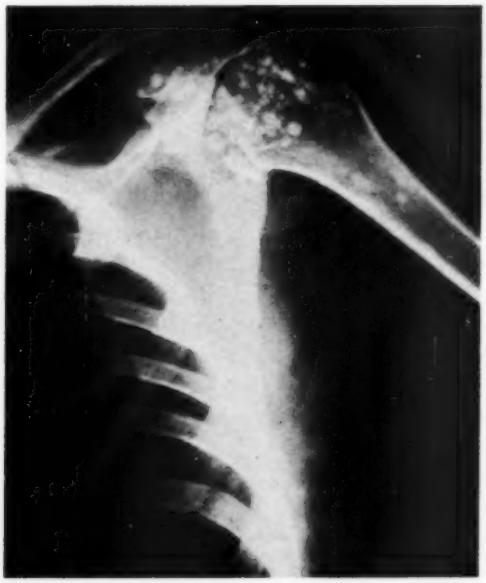


Fig. 4. Anterposterior roentgenogram of shoulder. Note the para-articular involvement and the absence of lesions in the ribs and clavicle. In the shaft of the humerus, and other long bones, only occasional dense areas are present.

Following the discovery of the condition in this patient, a survey of all available family members was undertaken, and similar lesions were found in her father, 2 sisters, and 1 brother. Some nine years earlier the brother had had a roentgenographic examination of the hip following an injury and was at that time suspected of having tuberculosis of the bone. His subsequent course and the family incidence of osteopathia condensans disseminata indicate that this was an incorrect assumption.

Figures 1 to 4 provide a representative spectrum of the lesions, their type, and distribution, in the group of patients presented above.

SUMMARY

Five cases of osteopathia condensans disseminata are added to those recorded in the literature. These were found in a family

group, adding further evidence of the hereditary nature of this condition. As previously noted by Busch, the condition was transmitted through the father to his children. In this instance, all of the children were affected.

Further evidence is presented as to the asymptomatic, benign nature of this disorder. It is suggested that the term osteopathia condensans disseminata is preferable to such designations as osteopoikilosis, osteosclerosis, fragilitas generalisata, and others which have been used in the past.

110 North First, East
Logan, Utah

REFERENCES

1. LOWREY, J. M., AND BOOTH, J. H. R.: Osteopathia Condensans Disseminata, "Spotted Bones," with Report of a Case. Am. J. Roentgenol. **37**: 774–781, June 1937.

2. STIEDA, A.: Über unschriebene Knochenverdichtungen im Bereich der Substantia spongiosa im Röntgenbilde. Beitr. z. klin. Chir. **45**: 700–703, 1905.

3. ŠVÁB, V.: A propos de l'ostéopoecilie héréditaire. J. de radiol. et d'électrol. **16**: 405–415, September 1932.

4. WILCOX, L. F.: Osteopoikilosis (Disseminated Condensing Osteopathy). Am. J. Roentgenol. **27**: 580–584, April 1932.

5. HOLLY, L. E.: Osteopoikilosis: Five Year Study. Am. J. Roentgenol. **36**: 512–517, October 1936.

6. BUSCH, K. F. B.: Familial Disseminated Osteosclerosis. Acta radiol. **18**: 693–714, 1937.

7. VOORHOEVE, V.: L'image radiologique non encore d'écrite d'une anomalie du squelette. Acta radiol. **3**: 407–427, 1924.

8. WINDHOLZ, F.: Über familiäre Osteopoikilie und Dermatofibrosis lenticularis disseminata. Fortschr. a. d. Geb. d. Röntgenstrahlen **45**: 566–582, May 1932.

9. POKORNY, A., AND POKORNY, L.: Zur Kenntnis der Dermatofibrosis lenticularis disseminata. Dermat. Wchnschr. **88**: 157–161, Feb. 2, 1929.

10. BUSCHKE, A., AND OLLENDORFF, H.: Ein Fall von Dermatofibrosis lenticularis disseminata und Osteopathia condensans disseminata. Dermat. Wchnschr. **86**: 257–262, Feb. 25, 1928.

11. SCHMORL, G.: Anatomische Befunde bei einem Falle von Osteopoikilie. Fortschr. a. d. Geb. d. Röntgenstrahlen **44**: 1–8, July 1931.

12. FUNSHTEYN, L., AND KOTSCHIEW, K.: Über die Osteopoikilie. Fortschr. a. d. Geb. d. Röntgenstrahlen **54**: 595–603, December 1936.

13. NICHOLS, B. H., AND SHIFLETT, E. L.: Osteopoikilosis. Report of an Unusual Case. Am. J. Roentgenol. **32**: 52–63, July 1934.

14. NEWCOMET, W. S.: "Spotted Bones." Am. J. Roentgenol. **22**: 460–463, November 1929.

SUMARIO

Osteopatía Condensante Diseminada

Agréganse 5 casos de osteopatía condensante diseminada a los 81 descubiertos en la literatura. Estos casos nuevos ocurrieron en un grupo familiar, aportando así nueva prueba de la naturaleza hereditaria de la afección. Según se ha señalado antes, la transmisión fué por vía paterna a los hijos. En este caso, se afectaron todos éstos, un varón y tres mujeres.

El cuadro radiográfico revela hueso compacto, apareciendo en forma de zonas blancas, redondeadas, ovales o alargadas de mayor densidad y de 0.2 a 1.0 cm. de diámetro, parecidas a bolas de algodón, reposando dentro de la médula ósea. La forma suele ser esférica, pero puede ser oval, en cuyo caso el eje largo de la lesión queda paralelo al del hueso o, en los huesos planos o las epífisis, sigue la dirección general de las trabéculas. El contorno y las características generales de los huesos afectados son en lo demás normales. Los lesiones tienden a localizarse en los puntos de tensión o de movimiento.

Apórtanse más pruebas de la naturaleza benigna y asintomática de este trastorno.

Aneurysm of an Anomalous Right Subclavian Artery[1]

ALBERT M. McCALLEN, M.D.,[2] and BURNETT SCHAFF, M.D.[3]

AN ANOMALOUS right subclavian artery arising as the fourth branch from the left side of the aortic arch is one of the most common anomalies of the great vessels. The frequency of recorded examples has recently increased due to greater interest on the part of surgeons in cardiovascular disorders. Felson *et al.* (5) covered the subject thoroughly in their report of 9 cases. Copleman (4) has also published an excellent discussion of the anomaly. The literature thus far fails to show a true aneurysm of this vessel, although a diverticulum of the aorta, often observed at the origin of the anomalous right subclavian, has been referred to as having an aneurysmal origin.

In the case to be presented here a true aneurysm of an anomalous right subclavian artery was demonstrated roentgenographically and proved at autopsy.

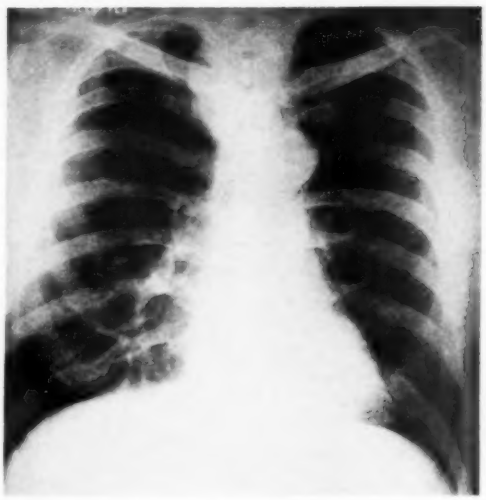


Fig. 1. Routine postero-anterior chest film showing mass to the right of the superior mediastinum above the level of the aortic arch.

CASE HISTORY

A 50-year-old white male, well developed and well nourished, was admitted to the hospital with pain in the lower abdomen of three weeks duration, intermittent claudication, and impotence. Two and one-half years earlier he had collapsed at work and had been treated for a period of six weeks for a cardiac condition. There was no history of dysphagia at any time.

Physical Examination: The patient's blood pressure was 190/110. Funduscopic examination revealed a Grade 2 arteriosclerosis. The lungs were clear, and the heart did not appear enlarged. A systolic murmur was present, transmitted to both subclavicular regions, but most pronounced on the right side.

Roentgenological Findings: The postero-anterior chest film revealed a fusiform mass of homogeneous density extending to the right of the mediastinum just above the aortic arch. Fluoroscopic examination showed no pulsation of the mass; it did not move with deglutition nor change in size with the Valsalva maneuver. The barium-filled esophagus was displaced anteriorly and to the right, with a wide pressure defect extending obliquely upward from left to right. The anterior displacement of the esophagus measured 2.5 cm. and the length of the defect 4.5 cm. The trachea was also displaced somewhat anteriorly and to the right and appeared flattened in its anteroposterior diameter.

Although the authors knew of no similar case, the esophageal deformity was considered characteristic of aberrant right subclavian artery, and a diagnosis of aneurysm of that artery was made.

A chest film obtained two years prior to the first admission was reviewed and appeared entirely normal. A gastrointestinal series showed no evidence of intrinsic disease of the esophagus, stomach, or duodenum. Anterior, posterior, and lateral scout films of the abdomen demonstrated a fusiform dilatation of the aorta with considerable calcification in the wall.

Bronchoscopy: Bronchoscopic examination revealed some bulging of the posterior wall of the trachea, slightly diminishing the lumen. The entire tracheobronchial tree danced from transmitted pulsations of the arterial structures. Such findings are often noted when an aneurysm is located near the tracheobronchial tree.

Clinical Course: A diagnosis of abdominal aortic aneurysm and Leriche's syndrome was made. No

[1] From the Radiological and Surgical Service, Veterans Administration Hospital, Coral Gables, Fla. Accepted for publication in February 1955.

[2] Chief, Radiological Service, VA Hospital, Coral Gables.
[3] Chief, Thoracic Surgery Section, VA Hospital, Coral Gables.

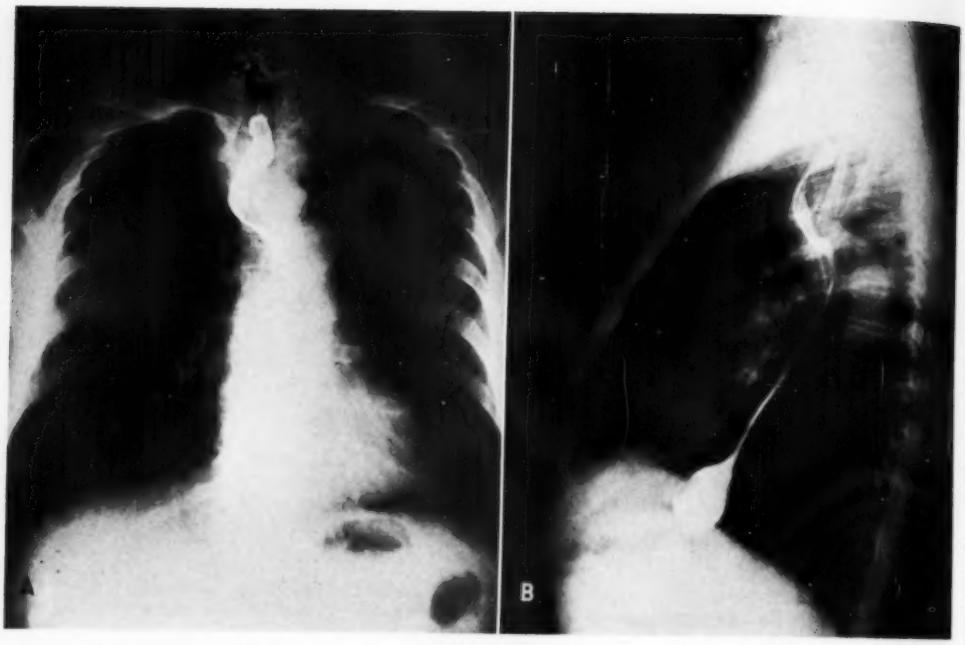


Fig. 2. Anteroposterior (A) and lateral (B) films showing pressure deformity and displacement of the barium-filled esophagus by aneurysm of an anomalous right subclavian artery.

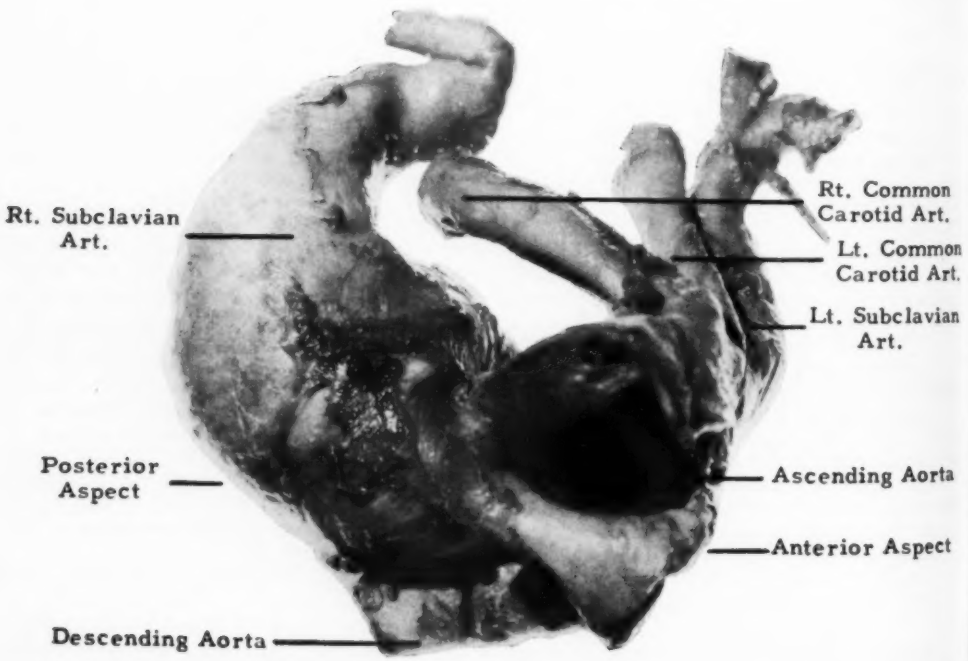


Fig. 3. Postmorten specimen of aortic arch and its branches viewed from right side. The aneurysm has been displaced downward from its original position for better visualization.

treatment was recommended. The Chest Therapy Board advised exploration for the superior mediastinal mass, and one month later a thoracotomy was performed. An expansile, pulsating structure was seen, arising from behind the trachea and esophagus and disappearing into the base of the neck. The postoperative diagnosis was aneurysm of an anomalous right subclavian artery. The immediate course was uneventful except for the development of a serum homologous jaundice. The patient died two and one-half years after the exploration.

Autopsy Findings: At autopsy the aorta showed numerous atheromatous plaques. The first branch of the aortic arch was the right common carotid, followed in order by the left common carotid, left subclavian artery, and anomalous right subclavian artery. This last vessel arose from the posterior aspect of the aortic arch as its fourth branch. It passed posteriorly, to the right, and upward behind the three other branches and the esophagus.

The first three branches were of normal caliber and showed no atheromata. The anomalous right subclavian had an orifice of normal dimensions and was of normal caliber for the first 2 cm. It then widened into a thick-walled, fusiform aneurysm measuring 8 cm. in length and 4 cm. in width.

The descending thoracic and abdominal aorta showed considerable atherosclerosis and a large, ruptured, abdominal aneurysm was observed. The heart weight was 350 gm. No congenital cardiac anomalies were present; the heart valves and chambers were normal.

SUMMARY

A case of acquired arteriosclerotic aneurysm of an anomalous right subclavian artery is presented. A search of the literature failed to reveal any previously reported case.

Aneurysm of an anomalous right subclavian artery is a condition which must be considered in differential diagnosis of superior mediastinal masses.

Veterans Administration Hospital
Coral Gables, Fla.

REFERENCES

1. ANSON, B. J.: Anomalous Right Subclavian Artery: Its Practical Significance, with Report of 3 Cases. Surg., Gynec. & Obst. **62**: 708–711, April 1936.
2. BREAN, H. P., AND NEUHAUSER, E. B. D.: Syndrome of Aberrant Right Subclavian Artery with Patent Ductus Arteriosus. Am. J. Roentgenol. **58**: 708–716, December 1947.
3. CAIRNEY, J.: Anomalous Right Subclavian Artery Considered in the Light of Recent Findings in Arterial Development. J. Anat. **59**: 265–296, April 1925.
4. COPLEMAN, B.: Anomalous Right Subclavian Artery. Am. J. Roentgenol. **54**: 270–275, September 1945.
5. FELSON, B., COHEN, S., COURTER, S. R., AND MCGUIRE, J.: Anomalous Right Subclavian Artery. Radiology **54**: 340–349, March 1950.

SUMARIO

Aneurisma de una Arteria Subclavia Derecha Anómala

Preséntase un caso de aneurisma arteriosclerótico adquirido de una arteria subclavia derecha anómala en un sujeto de cincuenta años de edad. Un repaso de la literatura no reveló ningún caso anterior de este estado.

Una radiografía postero-anterior del tórax reveló una tumefacción fusiforme de densidad homogénea que se extendía a la derecha del mediastino precisamente más arriba del cayado de la aorta. El examen radioscópico no mostró pulsación de la masa. El esófago, lleno de bario, parecía estar desplazado hacia el frente y a la derecha, con una imperfección ancha creada por la compresión que se extendía oblicuamente hacia arriba de izquierda a derecha. La tráquea también estaba desplazada algo al frente y a la derecha y parecía hallarse aplastada en su diámetro anteroposterior. El diagnóstico radiológico de aneurisma de una arteria subclavia derecha anómala fué confirmado después al operar y en la autopsia.

Instase a que, en el diagnóstico diferencial de las tumefacciones del mediastino superior, se considere el aneurisma de una arteria subclavia derecha anómala.

Fibrin Body in an Old Abscess Cavity, Simulating a New Growth[1]

WILLIAM E. GANNON, M.D.,[2] and HENRY GREENFIELD, M.D.[3]

In 1922 Fleischner (1) first reported the presence of opaque bodies which he observed floating in the pleural exudate in an artificial pneumothorax cavity. He stated that "during deep inspiration the level of the fluid was lowered and there appeared above the surface of the effusion a sharply defined, rounded, homogeneous shadow, the shape and size of a silk cocoon, whose position in the pleural cavity could be changed by shifting the patient from side to side, and whose specific gravity was apparently higher than that of the surrounding fluid." He believed that these bodies were composed of fibrin and came about as a result of the conglomeration of the small fibrin flakes that are often found in pleural exudates.

Düll (2), in a report of 3 cases in 1925, expressed the view that these masses arose from blood fibrin as the result of hemorrhage into the pleural cavity following rupture of an intercostal artery during a pneumothorax refill. The blood fibrin then settled out, forming the so-called *Blutfibrinkugeln* (blood-fibrin ball).

Cases coming to autopsy have been described by Stöffel (3), Wischnowitzer (4), Pomelzoff (5), Goljajew (6), and Zavod (7). In all instances the masses consisted of pure fibrin, histologically and chemically. Stöffel believed that the fibrin was deposited about a nidus of some sort, possibly an adhesion that had been torn during a refill.

Brandt (8) produced fibrinoplastic bodies in the pleural cavities of dogs by injecting scharlach R and tar. He believed that a nucleus must be present, and that blood fibrin plays a part in the formation of these bodies. He observed that the surfaces of the fibrin bodies which are in contact with the pleura or diaphragm are rough and, therefore, may act as irritants. Poindecker (9) also regarded the condition of the pleura as an important factor in the production of these bodies.

H. G., a 67-year-old white male, first entered Kings County Hospital on March 1, 1945, with a history of a productive cough of two months duration and fever and chest pain for ten days prior to admission. The physical findings were consistent with a right upper lobe pneumonia. The sputum was blood-tinged and the temperature was 102°. Roentgenograms showed consolidation of the upper two-thirds of the right lung field. Type 22 pneumococcus was cultured from the sputum. Both sputum and gastric studies were negative for tuberculosis.

After three weeks of treatment by penicillin and sulfa drugs, a further roentgen study showed a density in the posterior segment of the right upper lobe considered to be a lung abscess. This was again observed two weeks later. Bronchoscopy revealed pus oozing from an inflamed right upper lobe ostium.

The patient left the hospital against advice on April 23, but was readmitted a month later (May 21) with a chronic cough. There was no hemoptysis, and bronchoscopic findings were normal. A biopsy of the right upper lobe was reported as negative for malignant cells. On July 5, an exploratory thoracotomy was performed. The right upper lobe was found to be diffusely infiltrated, with an appearance characteristic of chronic inflammatory pneumonitis. No mass was palpable. Two biopsy specimens obtained at the time of operation were reported as showing "chronic interstitial fibrosis of the lung; lung infarction." The patient was discharged on Sept. 20, 1945.

On Nov. 18, 1948, the patient was again admitted, complaining of intermittent fever and chronic cough with the production of foul sputum, occasionally blood-streaked, since his previous discharge. Sputum and gastric studies were again negative for tuberculosis. He left the hospital on Dec. 16.

The fourth hospital admission was on June 9, 1950, with the same history as before. Roentgenograms showed a cavity in the right upper lobe. The diagnosis of chronic lung abscess and bronchiectasis was made. Tests for tuberculosis were negative. The patient was discharged to the follow-

[1] From the Departments of Radiology and Thoracic Surgery, Kings County Hospital, Brooklyn, N. Y. Accepted for publication in April 1955.

[2] Resident in Radiology, Kings County Hospital.
[3] Attending Roentgenologist, Kings County Hospital.

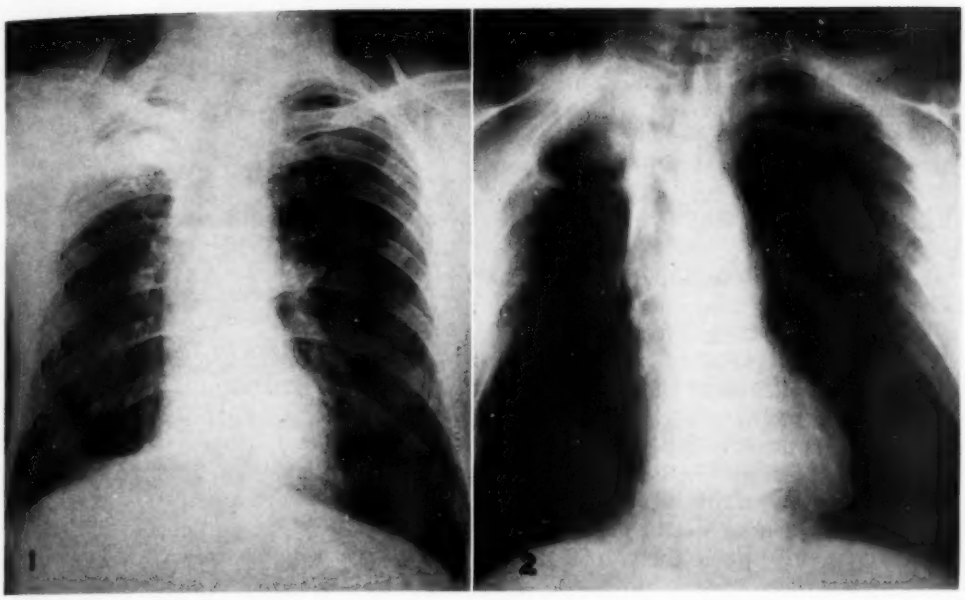


Fig. 1. Plain postero-anterior roentgenogram of the chest. The cavity in the right upper lobe is visible but the mass is not demonstrated.

Fig. 2. Anteroposterior tomogram of the chest clearly demonstrating the mass in the center of the cavity in the apical and posterior segment of the right upper lobe.

up clinic, but was readmitted on Feb. 26, 1951. Again tests for tuberculosis were negative, as were the bronchoscopic findings and bronchial washings. No evidence of bronchiectasis was obtained on bronchography, but the residual abscess in the right upper lobe was again observed.

The patient was subsequently followed in a Board of Health clinic. He continued to have a chronic cough and occasional hemoptysis. On Oct. 15, 1954, he had a severe bout of hemoptysis and entered the hospital the next day. The only pertinent physical finding was clubbing of the fingers. Temperature, pulse, respiration, blood pressure, white blood count, and hemoglobin were normal. The erythrocyte sedimentation rate was slightly elevated. There had been no recent weight loss. Hemoptysis continued for the first few days of his hospital stay. A plain roentgenogram of the chest revealed the previously described cavity, but a mass was now present at its center (Fig. 1). Anteroposterior tomograms also showed this cavity in the apical and posterior segment of the right upper lobe, with a well circumscribed central mass, measuring roughly 2.5 cm. in diameter (Fig. 2). In view of the history of repeated hemoptysis, it was considered likely that this mass represented a new growth.

An exploratory thoracotomy was performed on Dec. 14, 1954. An ovoid cavity, about 6 cm. in diameter, was discovered in the apical and posterior segments of the right upper lobe. This cavity was entered and found to contain a rather loose, soft, fibrinous yellowish body about 4 cm. in diameter, surrounded by fresh blood. No other abnormalities were noted. The interior of the cavity appeared to be epithelialized and the source of the recent bleeding was not apparent. A biopsy of the surrounding lung was reported as showing "dense connective tissue lined by flattened epithelium and occasional cuboidal cells." The mass was removed, the cavity was plicated, and the patient made an uneventful recovery.

DISCUSSION

Fibrin bodies are not confined to the pleural cavity. As early as 1844, Rokitansky (10) reported their occurrence in the pericardial sac following a serous pericarditis. They have frequently been found in the peritoneal cavity. Flottmann (11) described fibrin stones which developed in the kidney pelvis. He felt that congestion, active bleeding, and some alteration in the colloidal state played the most important part in their production.

Fibrin bodies in the pleural cavity are usually associated with long standing cases of hydropneumothorax. Robins and Jor-

ess (12) state that the shortest interval between the induction of pneumothorax and their discovery was thirteen months and the longest about seven years. These bodies are asymptomatic and are usually an incidental roentgen finding. Over a period of time they may decrease in size due to loss of fluid (13) or may disappear entirely (14).

It is generally assumed that some form of pleural fluid is essential for the production of fibrin bodies. Lyons (15), however, has reported a case presumably occurring in the absence of pleural fluid. It would appear from our case also that the presence of a pleural effusion is not essential for the production of fibrin bodies in cases of pneumothorax. In this instance the fibrin body was apparently due to repeated hemorrhage into the epithelialized abscess cavity with the formation of a blood fibrin ball. The possibility that some detritus in the cavity may have acted as a nidus cannot be excluded.

SUMMARY

1. A case of fibrin body in an old epithelialized abscess cavity simulating a new growth is reported.

2. A brief résumé of the literature is presented.

3. It is suggested that actual hemorrhage and not the conglomeration of fibrin flakes from pleural exudate is the cause of the formation of fibrin bodies.

855 Ocean Avenue
Brooklyn, N. Y.

REFERENCES

1. FLEISCHNER, F.: Kugelförmige Gebilde in der Pleurahöhle bei Pneumothorax. Mitt. d. Gesellsch. f. inn. Med. u. Kinderh. **2**: 94, 1922.

2. DÜLL, W.: Vorkommen von Blut-Fibrinkugeln im Pneumothoraxraum. Beitr. z. Klin. d. Tuberk. **60**: 307, 1924–1925.

3. STÖFFEL, H.: Fibrinkörper im Pneumothoraxraum. Fortschr. a. d. Geb. d. Röntgenstrahlen **34**: 548–551, 1926.

4. WISCHNOWITZER, L.: Fibrinkörper im Pneumothoraxraum (Obduktionsbefund). Beitr. z. Klin. d. Tuberk. **67**: 773–774, 1927.

5. POMELZOFF, K.: Über freie Fibrinkörper im Pleuralraum. Beitr. z. Klin. d. Tuberk. **69**: 491–494, 1928.

6. GOLJAJEW, A. W.: Zur Frage der freien Fibrinkörper in der Pleurahöhle. Frankfurt. Ztschr. f. Path. **38**: 75–80, 1929.

7. ZAVOD, W. A.: Fibrin Bodies in the Pleural Space in a Case of Artificial Pneumothorax with Necropsy. Am. Rev. Tuberc. **33**: 48–54, January 1936.

8. BRANDT, M.: Über freie Körper in Pleuraraum. Virchow's Arch. f. path. Anat. **263**: 574–583, 1927.

9. POINDECKER, H.: Fibrinkugel im Pneumothoraxraum. Beitr. z. Klin. d. Tuberk. **61**: 243, 1925.

10. ROKITANSKY, C.: Handbuch der pathologischer Anatomie, 1844.

11. FLOTTMANN, W.: Über Fibrinsteine des Nierenbeckens. Virchow's Arch. f. path. Anat. **261**: 685–699, 1926.

12. ROBINS, S. A., AND JORESS, M. H.: Intrapleural Fibrin Bodies. Observations on Their Development During Pneumothorax Treatment. Am. Rev. Tuberc. **37**: 81–87, January 1938.

13. VOIT, E.: Die Säurebindung und Quellung des Fibrins. Ztschr. f. Biol. **87**: 269–278, 1928.

14. KLINKOWSTEIN, J., AND BELAJEWA, N.: Fibrinkugeln im Pneumothoraxraum. Beitr. z. Klin. d. Tuberk. **63**: 313–316, 1926.

15. LYONS, C. G.: Fibrin Bodies. Case Report. Am. J. Roentgenol. **42**: 532–533, October 1939.

SUMARIO

Cuerpo Fibrinoso en la Cavidad de un Absceso Antiguo (Simulando Neoplasia)

Comunícase un caso de cuerpo de fibrina en la cavidad epitelializada de un absceso antiguo, simulando neoplasia. En esta ocasión, el cuerpo de fibrina se debía aparentemente a hemorragias repetidas en la cavidad epitelializada del absceso, con la formación de una bola de fibrina sanguínea. No cabe excluir la posibilidad de que algunos detritos en la cavidad sirvieran de nido.

Meconium Ileus: A New Roentgen Sign

HARVEY WHITE, M.D.

MECONIUM ILEUS was first described in 1905 by Landsteiner (1), who correlated its occurrence with pathologic changes in the pancreas. In 1942, Kornblith and Otani (2) reported a case of meconium ileus with stenosis of the duct of Wirsung. Farber (3) in 1944 demonstrated that pancreatic insufficiency *in utero* resulted in abnormal meconium, which was thick, sticky, and mucilaginous. Pathologically the pancreas revealed atrophy of the exocrine glands, obstruction of the ducts by inspissated material, and an increase in the connective tissue.

Baggenstoss, Power, and Grindlay (4) concluded from their studies that pancreatic insufficiency is due to congenital atresia of the ducts. All agree that the absence of pancreatic enzyme results in meconium which is so altered in its consistency that it can produce intestinal obstruction in the newborn. Failure of digestion of fats and protein is the primary cause of the thickening and inspissation of the meconium.

Neuhauser (5) described the bubble appearance of air mixed with thick meconium, as demonstrable roentgenographically, diagnostic of meconium ileus. This was present in 40 per cent of his cases. Bruwer and Hodgson (6), however, have pointed out that this sign is not specific, having seen it in a case of imperforate anus. This has been our experience, also.

The clinical and pathologic aspects of fibrocystic disease and meconium ileus have been adequately reviewed (6–10) and will not be considered here. The purpose of this paper is rather to call attention to a roentgen sign not previously described, which is believed to be diagnostic of uncomplicated meconium ileus. In the medical literature, note is made of the presence of dilated gas-filled loops of bowel as an indication of intestinal obstruction (6, 11, 12). No mention, however, is made of fluid levels. Whether this is due to incomplete roentgen examination or whether the fluid levels were not actually present could not be determined.

Kaufmann and Chamberlin (13) report a case of congenital atresia of the pancreatic duct with meconium ileus associated with air-fluid levels. This observation was made two hours after gastric gavage with barium sulfate and cannot be attributed to fluid primarily accumulating in the bowel.

Hiatt and Wilson (10) reported 7 cases of meconium ileus of which only 1 was uncomplicated by volvulus, gangrene, perforation, or peritonitis. Fluid levels in the small bowel are mentioned in this case, but no roentgenogram is reproduced.

Ten cases of meconium ileus are reviewed here. Four of these were complicated by volvulus, gangrene, or peritonitis, and came to surgery or autopsy. In all, fibrocystic disease proved to be present. Six were uncomplicated, and it is with these that we are primarily concerned. There were 2 deaths following laparotomy in this group, and autopsy confirmed the diagnosis of fibrocystic disease. The other 4 patients survived after surgical removal of the meconium plug and introduction of panteric granules into the small bowel. Subsequent examination of the duodenal drainage or stool demonstrated absence or diminution of pancreatic activity in 3 cases. No further studies were made in the fourth patient, but at operation classic findings were present. Three of the patients are still alive and are reasonably well. The other died months after leaving the hospital, from intestinal obstruction.

The roentgen examination of the abdomen in the newborn period, in the presence

[1] From the Department of Radiology, Children's Memorial Hospital, Chicago, Ill. Accepted for publication in April 1955.

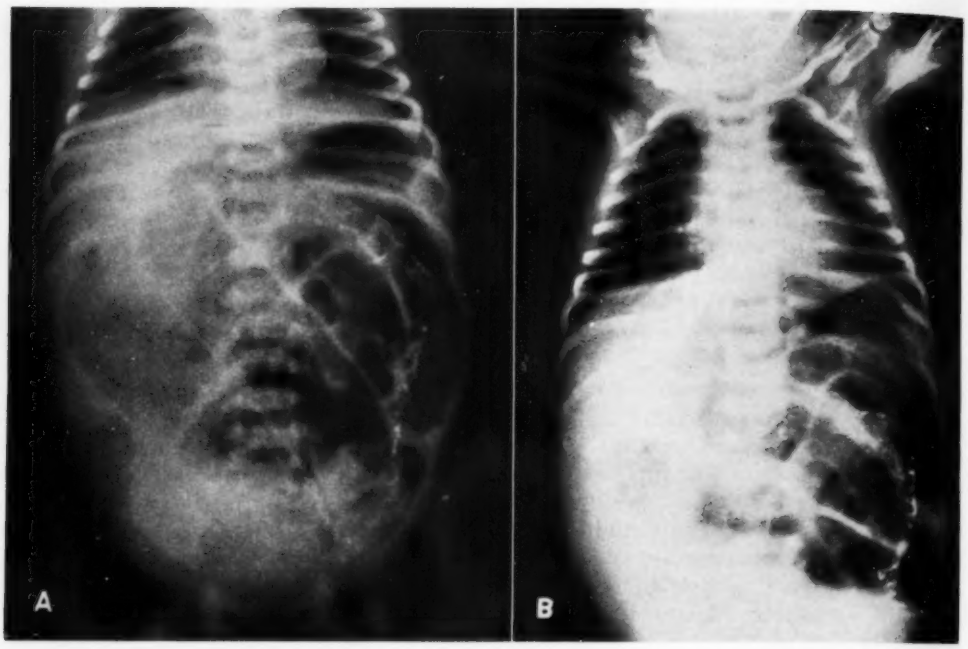


Fig. 1. Case I. Supine (A) and upright (B) roentgenograms of abdomen at the age of twenty-six hours in uncomplicated meconium ileus. Dilated loops of small bowel with no fluid levels are evident in the upright position.

of clinical signs of bowel obstruction (vomiting, distention, etc.), is of diagnostic importance. This should always include, as a minimum, studies in the supine and upright positions. In the supine position information is obtained as to the amount, pattern, and position of gas-filled loops of bowel. In the upright position the presence of fluid levels in the bowel and subdiaphragmatic air are sought. Normally, there is a moderate amount of gas in the small bowel in infants, visible six to twelve hours after birth (14). This is due to swallowed air. The bowel, however, is not dilated and fluid levels are not usually present. With few exceptions, roentgenographic studies of the abdomen showing dilated loops of small bowel associated with fluid levels merit a diagnosis of ileus. This picture is almost always seen in mechanical obstructions of the small bowel due to such causes as atresia, malrotations, volvulus, fibrous bands, etc. In our experience, uncomplicated meconium ileus is an exception to this rule.

Studies of surgical and autopsy material leave little doubt that complete obstruction occurs as the result of thick, impacted abnormal meconium. The bowel is dilated proximal to the obstruction; distally it is small and collapsed.

The roentgen findings were constant in the 6 uncomplicated cases of meconium ileus reported here. Dilated loops of small bowel were demonstrated in the supine position, indicating the presence of ileus (Fig. 1A), but in the upright position fluid levels were either absent or present in an insignificant degree (Fig. 1B). This is contrary to the usual findings in obstructive ileus. Duration of the obstruction did not appear to be a contributing factor, as some of the patients were four days old at the time of examination.

It is of interest to theorize concerning the absence of fluid levels in this condition, and a brief review of the physiology of ileus seems warranted. Golden (15) defines ileus as dilatation of the small bowel, or a portion thereof, associated with an accu-

mulation of gas and fluid as well as other physiological disturbances. Hibbard, Swenson, and Levin (16) have demonstrated on dogs that gas accumulates in small bowel obstruction in three and one-half hours, and fluid in six to seven hours. Ochsner (18) states that accumulation of fluid in obstruction is the result of increased secretion and diminished absorption from the mucosa of the bowel.

In patients with meconium ileus, considerable difficulty is experienced in removal of the meconium either at surgery or at autopsy. Only after the use of large amounts of saline can the meconium be separated from the mucosa. Because of the initimate contact of this sticky, mucilaginous material with the mucosa, some interference with normal physiology is conceivable. If this assumption is correct, mucosal secretion may be prevented or at least diminished in degree as compared with the common types of mechanical obstruction. In addition to this probable mechanical interference, there is physiological evidence of disturbed duodenal secretion in children with fibrocystic disease, as reported by Maddock, Farber, and Shwachman (17). They found that in the normal infant the duodenum responded with increase in secretion on stimulation with secretin. In infants with fibrocystic disease no such increase occurred.

The above-mentioned factors seem to explain the absence of fluid levels on the roentgenograms in uncomplicated meconium ileus. This diagnostic sign is not to be seen, however, in the presence of such complications as volvulus, gangrene, and peritonitis. After these complications arise, the classic signs of obstructive ileus with dilated loops of bowel and fluid levels appear (Fig. 2). The explanation of these fluid levels is not clear, but probably lies in the presence of proteolytic enzymes released by infection and vascular occlusion. These enzymes may attack the meconium, rendering it more fluid.

CASE I: R. R., a 1-day-old white girl, was admitted to Children's Memorial Hospital with a history of persistent vomiting and no passage of stool.

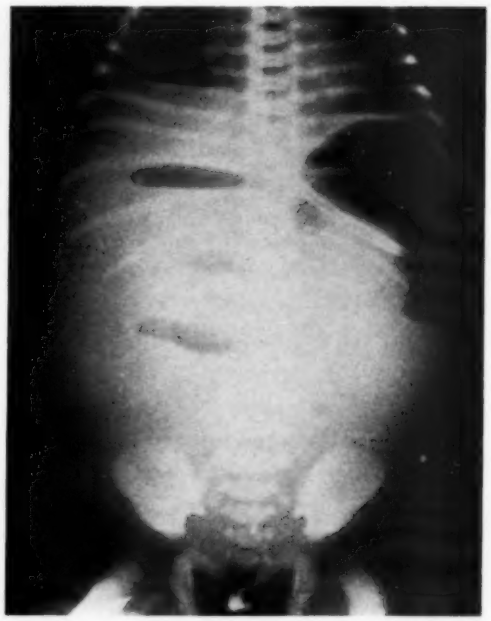


Fig. 2. Meconium ileus associated with gangrene of the bowel. Upright roentgenogram of the abdomen demonstrating isolated loops of bowel with fluid levels.

The abdomen was distended and small masses could be felt. On rectal examination no stool was present on the examining finger. Roentgenograms revealed multiple slightly dilated gas-filled loops of bowel, without fluid levels in the upright view (Fig. 1). At operation, the lower two-thirds of the ileum was found to be full of ropy, hard meconium. Subsequent study disclosed no trypsin activity in the stools. The child was discharged from the hospital in good condition and has since remained well on medical management.

CASE II: W. S., a 4-day-old white boy, was admitted to the hospital with a history of vomiting since birth. No stools had been passed. Physical examination revealed dehydration, abdominal distention, and visible loops of bowel. Rectal examination failed to show any meconium. Roentgenograms, supine and upright, disclosed multiple dilated loops of bowel throughout the abdomen, with no fluid levels. At operation, thick, sticky, hard, inspissated meconium was removed from the distal ileum. Stool examination for trypsin activity failed to reveal any digestion of gelatin film. The child recovered following surgery and left the hospital in good condition, but pulmonary changes consistent with fibrocystic disease of the pancreas subsequently developed.

CASE III: R. C., a white boy 3 days old, was admitted to the hospital showing abdominal distention and visible and palpable dilated loops of

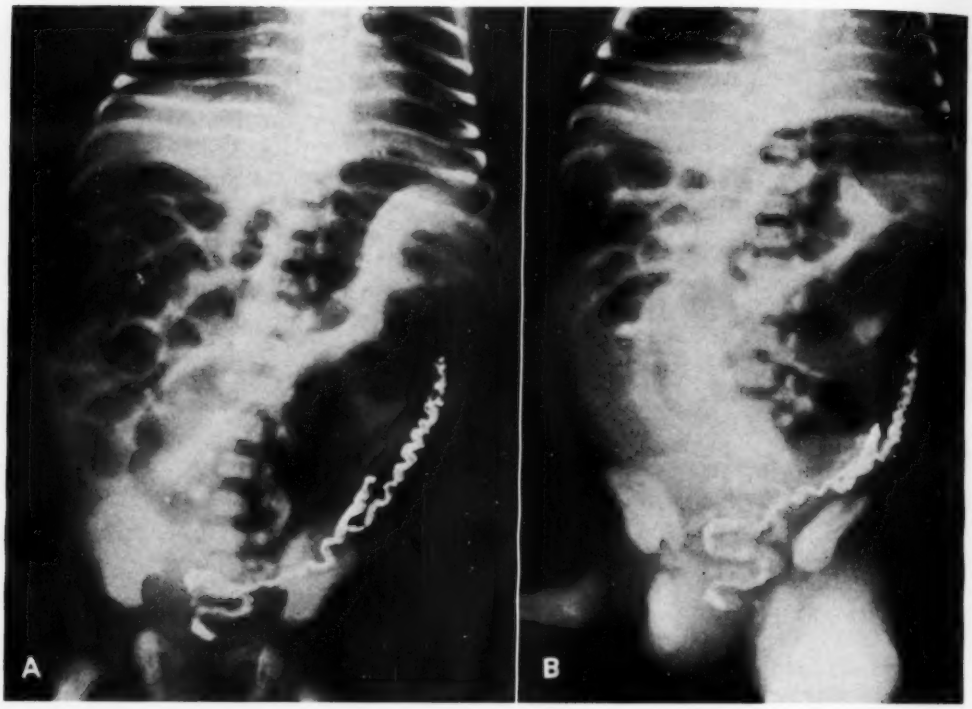


Fig. 3. Case VI. Uncomplicated meconium ileus. Supine (A) and upright (B) abdominal roentgenograms at three days of age, showing dilated gas-filled loop of bowel with no fluid level in the upright view.

bowel. No stools had been passed since birth. Roentgenograms of the abdomen in the supine and upright positions demonstrated multiple dilated loops of bowel without fluid levels. At exploratory laparotomy, performed on the day of admission, the distal ileum was found to be filled with hard, inspissated meconium and to diminish gradually in caliber as it approached the cecum. The colon appeared to be underdeveloped. Through an enterostomy, large amounts of thick, ropy meconium, so tenacious that it had to be pulled out with forceps, was removed. During the hospital stay, analysis of the duodenal secretions revealed absence of trypsin; the vitamin A curve was flat. The child recovered and was discharged in good condition.

CASE IV: K. W., a white girl 41 hours old, entered the hospital with a twenty-four-hour history of vomiting and abdominal distention. Flecks of meconium had been passed. Dilated loops of small bowel were palpable. Roentgenograms of the abdomen in the supine and upright positions demonstrated multiple dilated gas-filled loops of bowel with no fluid levels. At laparotomy on the second day of life, the distal ileum was found to be filled with solid, sticky material, which was removed through an enterostomy. The child recovered following operation and was discharged in good condition but died at the age of five and one-half months of intestinal obstruction due to adhesive peritonitis. Autopsy revealed fibrocystic disease of the pancreas.

CASE V: M. L., a white boy 68 hours old, entered the hospital with a history of increasing abdominal distention since birth. No stools were passed, and vomiting occurred with each feeding. Roentgenograms of the distended abdomen, in supine and upright positions, showed multiple, slightly dilated gas-filled loops of bowel with no fluid levels. At operation, the typical picture of meconium ileus was found. The small bowel down to the ileocecal valve was packed with putty-like meconium, which was removed with difficulty through an enterostomy. The infant recovered following surgery and has remained well since. No chemical studies on duodenal secretions were done.

CASE VI: M. N., a 3-day-old premature white boy weighing 5 pounds, was admitted to the hospital with a history of no bowel movements and vomiting after each feeding. An older sibling had been operated upon for a similar condition and was subsequently found to have fibrocystic disease. The abdomen was distended. Roentgenograms in the supine and upright positions revealed slightly dilated small bowel without fluid levels (Fig. 3).

At operation, long, stringy, thick meconium was removed. The patient died, and autopsy confirmed the diagnosis of meconium ileus and fibrocystic disease.

These 6 cases were clinically similar, in that the classical signs of obstruction, *i.e.*, vomiting, distention, and obstipation, occurred during the first four days of life. The same roentgenographic signs were present in all: many gas-filled dilated loops of bowel on the supine film and absence of fluid levels on the upright film. In the differential diagnosis the following conditions should be considered: atresia and stenosis of the bowel, meconium ileus with complications, malrotation with volvulus, agenesis of the myenteric plexus, and imperforate anus. The first three of these are associated with prominent fluid levels on the upright abdominal roentgenogram. In agenesis of the myenteric plexus, gas ordinarily appears in the large bowel; this may also be determined by barium enema studies. Imperforate anus is easily differentiated by inspection.

CONCLUSION

In the presence of clinical intestinal obstruction of the newborn, demonstration of dilated loops of small bowel with no fluid levels on the upright abdominal roentgenogram warrants the diagnosis of uncomplicated meconium ileus.

REFERENCES

1. LANDSTEINER, K.: Darmverschlussdurch eingedicktes Meconium. Pankreatitis. Centralbl. f. allg. Path. u. path. Anat. **16**: 903–907, 1905.
2. KORNBLITH, B. A., AND OTANI, S.: Meconium Ileus with Congenital Stenosis of Main Pancreatic Duct. Am. J. Path. **5**: 249–262, May 1929.
3. FARBER, S.: Pancreatic Function and Disease in Early Life: Pathologic Changes Associated with Pancreatic Insufficiency in Early Life. Arch. Path. **37**: 238–250, April 1944.
4. BAGGENSTOSS, A. H., POWER, M. H., AND GRINDLAY, J. H.: Further Studies on Pathogenesis of Fibrocystic Disease of the Pancreas. Arch. Path. **51**: 510–517, May 1951.
5. NEUHAUSER, E. B. D.: Roentgen Changes Associated with Pancreatic Insufficiency in Early Life. Radiology **46**: 319–328, April 1946.
6. BRUWER, A., AND HODGSON, J. R.: Intestinal Obstruction in Fibrocystic Disease of the Pancreas. Am. J. Roentgenol. **69**: 14–21, January 1953.
7. ANDERSEN, D. H.: Cystic Fibrosis of Pancreas and Its Relation to Celiac Disease. Clinical and Pathologic Study. Am. J. Dis. Child. **56**: 344–399, August 1938.
8. FARBER, S.: Relation of Pancreatic Achylia to Meconium Ileus. J. Pediat. **24**: 387–392, April 1944.
9. WIGLESWORTH, F. W.: Fibrocystic Disease of the Pancreas. Am. J. M. Sc. **212**: 351–365, September 1946.
10. HIATT, R. B., AND WILSON, P. E.: Celiac Syndrome: Therapy of Meconium Ileus. Report of 8 Cases with Review of the Literature. Surg., Gynec. & Obst. **87**: 317–327, September 1948.
11. DODD, K.: Intestinal Obstruction Due to Meconium Ileus in a Newborn Infant. Case Report. J. Pediat. **9**: 486–491, October 1936.
12. BAKER, H. M., JR., AND SILVERMAN, S. B.: Meconium Ileus. Am. J. Dis. Child. **80**: 803–807, November 1950.
13. KAUFMANN, W., AND CHAMBERLIN, D. B.: Congenital Atresia of Pancreatic Duct System as a Cause of Meconium Ileus. A Critical Review of the Literature, with Report of One Case. Am. J. Dis. Child. **66**: 55–67, July 1943.
14. FRIMANN-DAHL, J., LIND, J., AND WEGELIUS, C.: Roentgen Investigations of the Neo-Natal Gaseous Content of the Intestinal Tract. Acta radiol. **41**: 256–268, 1954.
15. GOLDEN, R.: Radiologic Examination of the Small Intestine. Philadelphia, J. B. Lippincott Co., 1945.
16. HIBBARD, J. S., SWENSON, P. C., AND LEVIN, A. G.: Roentgenology of Experimental Mesenteric Vascular Occlusion. Arch. Surg. **26**: 20–26, January 1933.
17. MADDOCK, C. L., FARBER, S., AND SHWACHMAN, H.: Pancreatic Function and Disease in Early Life. Effect of Secretin on Pancreatic Function of Infants and Children. Am. J. Dis. Child. **66**: 370–375, October 1943.
18. OCHSNER, A.: Physiologic Considerations of Ileus. Am. J. Roentgenol. **37**: 433–442, April 1937.

Children's Memorial Hospital
707 Fullerton Ave.
Chicago 14, Ill.

SUMARIO

Ileo Mecónico. Nuevo Signo Roentgenológico

Descríbese aquí un signo radiológico que el A. considera diagnóstico de íleo simple por meconio. Repásanse 10 casos en lactantes de menos de cuatro días de edad, 6 de los cuales eran simples. Los hallazgos roentgenológicos en cada uno de los 6 fueron constantes; había asas dilatadas de intestino delgado observables en la posición supina, indicando la existencia de íleo; en la posición erguida o no había niveles de líquido o si existían era en forma insignificante.

Descríbense los trastornos fisiológicos y mecánicos asociados con la dolencia, sugiriéndolos como explicación de la ausencia radiográfica de niveles de líquido.

Beam Quality Determinations for a 2-Mvp Resonance Type X-Ray Generator[1]

NORMAN A. BAILY, Ph.D., and NORMAN S. BEYER, M.A.

THE PREDOMINANCE of forward scattering for high-energy electromagnetic radiation (1) led us to consider the effects of introducing large amounts of absorbing material in the path of such beams. A quantity of particular interest is the measured value of the half-value layer or effective energy of the beam. When large amounts of high density material, such as lead are traversed, considerable Compton scattering results. With passage through additional thicknesses of absorbing layer, both primary and scattered radiations will undergo further scattering. As this process proceeds, the high-energy end of the spectrum is continually reduced in energy. With increasing absorber thickness, the proportion of such scattering occurring at angles large enough to remove significant amounts of this radiation from the useful beam is augmented. In a situation where the distance between absorbers and the point of observation is great, it is conceivable that the experimentally determined transmission curves will decrease too rapidly. This can happen because some radiation will be scattered at angles large enough to cause these components to be lost from the useful beam and thus not be observed by the detecting device. The degree to which such an effect might be observed would be a function of the distance between absorber and detector. The greater this distance, the smaller the angle of scattering would have to be for the observation to be made. The experiment to be described shows the effect of such scattering on experimentally determined values of quality.

The use of the half-value layer as a designation of beam quality for radiation therapy purposes has been well established. The quality of interest is that of the actual beam which, impinging on the patient's skin, is sufficiently energetic to produce a biological action. We have chosen to express our results in terms of the half-value layer (h.v.l.) because of its general acceptance and because of the difficulties in determining an effective absorption coefficient from curves which are not straight lines in the region of interest.

A prerequisite for correct determination of beam quality is that the determination be made in a manner which does not in any way alter the beam. Such alteration can take place because of multiple scattering. When such scattering occurs, although the beam as a whole is hardened because of preferential absorption of the softer radiation, there will in general be a reduction in the energy of the hard components due to Compton scattering. These scattered x-rays will in turn undergo further scattering. The amount of such multiple scattering will, of course, be a function of the thickness and of the atomic number of the material through which it passes. As the higher energy components are reduced in energy, the proportion of scattered radiation reaching the detecting device will be a function, first, of the angular distribution of scattered radiation and, second, of the solid angle subtended by the detector. As shown by Heitler (1), the amount of radiation scattered through small angles, which can be detected by a small chamber at a long distance from the scatterer, will decrease with an increase in total scattering. When such radiation is lost to the detector, absorbers appear to be more effective than they actually are. A material of high atomic number (in this case lead) is a much more effective scatterer than air. The undisturbed beam which would reach the detector (or the patient's skin) will be different in quality from that which reaches the same destination when a con-

[1] From the Roswell Park Memorial Institute, Buffalo, N. Y. Accepted for publication in March 1955.

siderable amount of lead is introduced in the path of the beam.

To provide a common basis for beam quality specifications, two factors must be considered. First, the percentage of scattered radiation recorded by the detector will be shown to influence determinations of h.v.l. By scattered radiation is meant that which is scattered by absorbers introduced to make the measurement. Second, the wall thickness of the detector must be sufficient to eliminate the contributions from secondary radiations such as high-energy electrons generated in the absorbers.

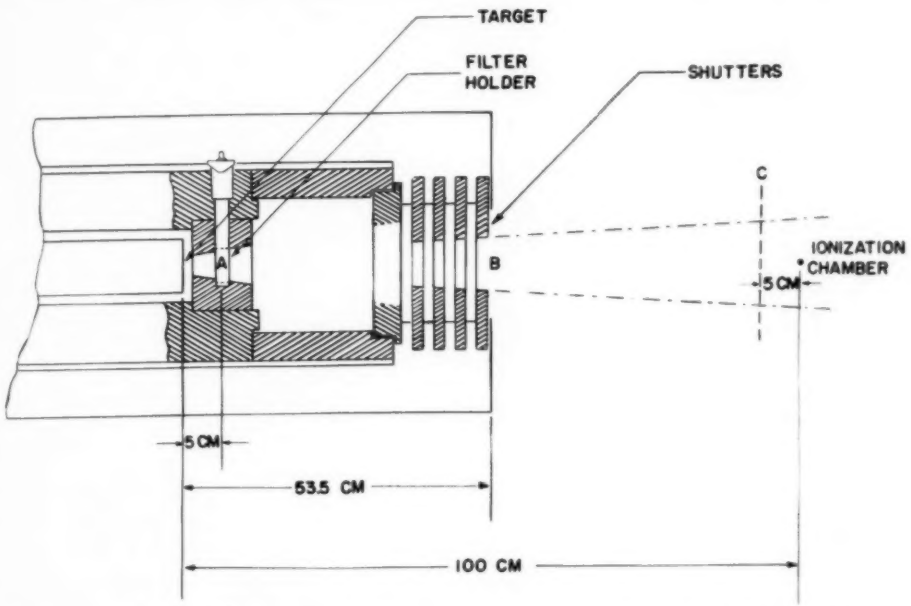


Fig. 1. Geometrical arrangement of absorbers in relation to x-ray tube target. Position A is approximately 5.0 cm. from the target, B is 53.5 cm., and C is 95.0 cm. The beam is collimated by lead shutters and diaphragms from the target to the point where it emerges into air at B. The field size at the position of the ionization chamber was 10 × 10 cm.

EXPERIMENTAL

The physical layout, illustrating the relationship between the x-ray generator, shutters and diaphragms, positions of absorbers and filters, and the detector, is shown in Figure 1. Points A, B, and C refer to the three positions at which absorbing material was placed during the experiment. Lead absorbers, used as filters to harden the primary beam, were always put in the filter holder provided by the manufacturer at position A. The beam dimensions at the point of measurement (100 cm. T.S.D.) were kept constant at 10 × 10 cm., this size being chosen because the shutter assembly was designed to match perfectly such a field. All the data were taken with the distance between the target and the center of the active volume of the ionization chamber equal to 100 cm. The size of the lead absorbers was 15 × 13 cm.

The ionization chamber used was a 250-r Victoreen chamber. In order to eliminate any contribution of secondaries generated in the lead by the primary beam and to establish equilibrium at these energies to the ionization recorded, the chamber was surrounded by a thick Bakelite cap, providing a total wall thickness of 5.3 mm. In order to ascertain whether this was sufficient to reduce the secondary electron

TABLE I: HALF-VALUE LAYERS FOR A G.E. 2-MVP X-RAY GENERATOR, WHEN LEAD ABSORBERS ARE PLACED AT DIFFERENT DISTANCES FROM THE TARGET

Initial Filtration	Half-Value Layer (mm. lead) at Different Distances from Target		
	95 cm.	53.5 cm.	5.0 cm.
0 mm. lead	7.24	5.66	5.84
1.0 mm. lead	7.64	6.10	6.52
5.0 mm. lead	9.74	7.48	7.72

The measurements for each curve were repeated using a 4.0-mm. aluminum absorber placed in contact with the lead absorbers and between the lead and the ionization chamber. It was determined experimentally that additional thicknesses of aluminum did not affect the amount of ionization recorded by the chamber until

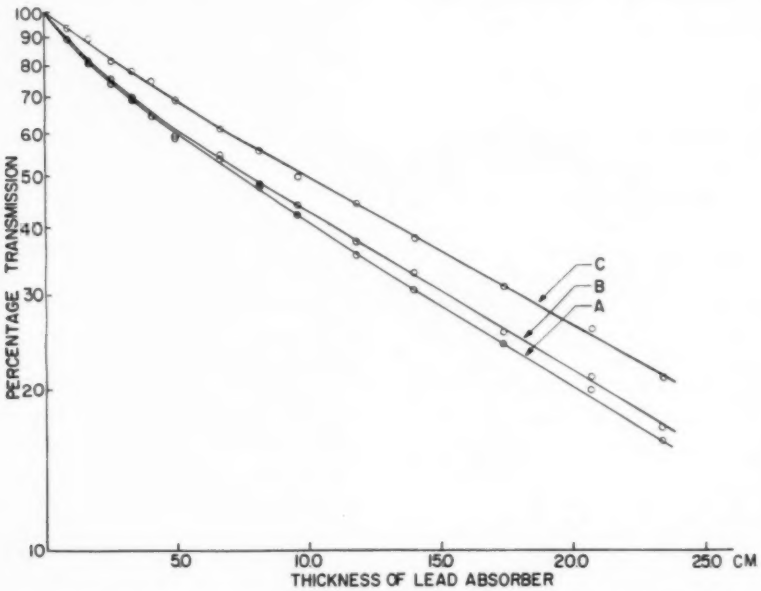


Fig. 2. Transmission curves for absorbers placed at 95.0 cm. from target. Curve A is for the unfiltered beam, curve B for a beam filtered by 1.0 mm. of lead, and curve C for a beam filtered by 5.0 mm. of lead.

contribution to a negligible degree, more Bakelite was added. The addition of several millimeters was found to have no discernible effect upon the observed ionization. The thickness of Bakelite used should completely stop electrons with energies up to approximately 1.5 Mev (2).

Transmission curves were determined by introducing absorbing layers of lead at positions B and C (Fig. 1) for beams of three different qualities. The quality was varied by placing lead absorbers (filtration) at position A. The three qualities were those obtained without filtration and with 1.0 and 5.0 mm. of lead. A transmission curve for all absorbing material at position A was also determined.

large amounts were reached. Transmission curves were drawn on the basis of these data, considering the value recorded for this thickness of aluminum, when it was the only absorber in the path of the beam, as the 100 per cent point. The transmission curves plotted in this fashion coincided exactly with those obtained when lead alone was used.

Both the 250-r chamber and the Victoreen r-meter used in this investigation were calibrated over the complete range of the instrument, with the use of a standard air chamber and 170-kvp x-ray beam filtered by 0.5 mm. Cu plus 1 mm. Al.

The possibility that the long path through air would affect the quality of

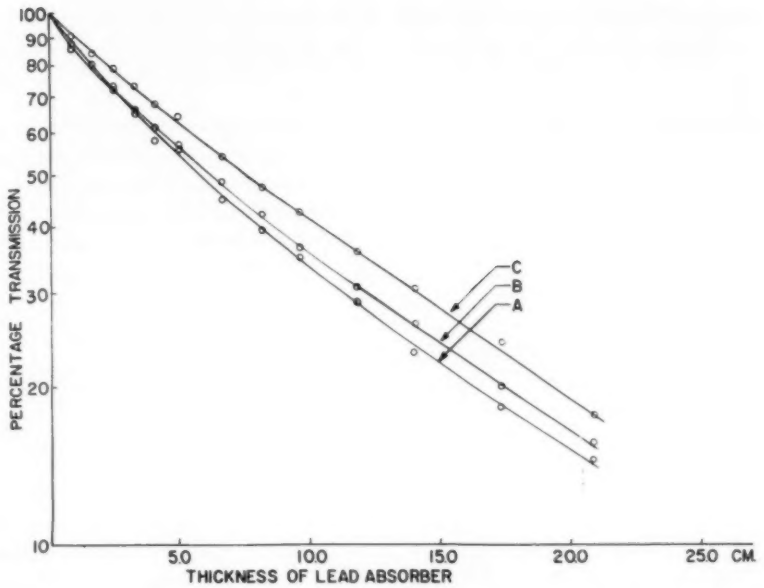


Fig. 3. Transmission curves for absorbers placed at 53.5 cm. from target. Curve A is for the unfiltered beam, curve B for the beam filtered by 1.0 mm. of lead, and curve C for a beam filtered by 5.0 mm. of lead.

primary beam reaching the detector, *i.e.*, that air scattering would cause significant loss in beam intensity of the low-energy components, was investigated. With no lead absorbers in place, air intensities were measured at 55 cm., 60 cm., 70 cm., 80 cm., and 90 cm. from the target. The ionization was found to obey the inverse-square-law relationship within the experimental error.

RESULTS

Transmission curves, obtained when the lead absorbers were placed 95 cm. from the target, are shown in Figure 2. The three curves refer to the 2-Mvp beam filtered by 0, 1.0, and 5.0 mm. of lead placed at position A. The intensity of the beam with these filters in place, but without additional lead in the beam path, was taken in each case as the 100 per cent value. The measured transmission curves for absorbers placed 53.5 cm. from the target and 46.5 cm. from the center of the ionization chamber's sensitive volume are shown in Figure 3. The initial filtration was again placed at position A. Half-value layers determined from both sets of curves are listed in Table I.

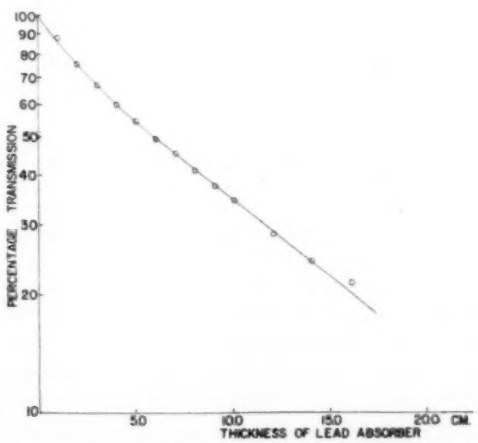


Fig. 4. Transmission curve for lead when all absorbers are placed 5.0 cm. from the target and 95.0 cm. from the center of the sensitive volume of the ionization chamber.

A transmission curve for lead absorbers placed at position A is shown in Figure 4.

Table I shows the half-value layer that would be obtained without filtration and with filters of 1.0 and 5.0 mm. of lead at this position.

The points used to determine the curves shown in Figures 2, 3, and 4 are averages of at least three independent determinations. The accuracy of the half-value layers tabulated is plus or minus 1.0 per cent.

DISCUSSION

It will be noted that, although there is a large increase in the measured half-value layer with the absorbing material 95 cm. from the target rather than at 5.0 cm., a slight but significant decrease is observed when the absorbers are at 53.5 cm. from the target. This we attribute to multiple scattering by the lead diaphragms and shutters. Soft radiation, which would be scattered out of the beam if these were not present, is scattered back into the sensitive volume. Since this multiple scattered radiation is of reduced energy, it will undergo large-angle scattering upon further passage through lead, and will not traverse the active volume, thus making the absorbers appear more effective than those placed 5.0 cm. from the ionization chamber.

Preliminary experiments show that these effects can also be observed at lower energies. A complete study of effects of the type described in this paper for several (lower) energies is now under way and will be reported at a later date.

CONCLUSION

Large amounts of absorbing material placed in the path of a high-energy x-ray beam will influence experimental determinations of beam quality. The variation in experimental values is a function of the position of such absorbers.

Roswell Park Memorial Institute
Buffalo 3, N. Y.

REFERENCES

1. HEITLER, W.: The Quantum Theory of Radiation. New York, The Macmillan Company, 2d ed., 1948, p. 156.
2. LAPP, R. E., AND ANDREWS, H. L.: Nuclear Radiation Physics. New York, Prentice-Hall, Inc., 1949, p. 180, eq. 8–11.

SUMARIO

Determinaciones de la Calidad del Haz para un Generador de Rayos X de Tipo de 2 Mvp de Resonancia

Se han investigado los efectos producidos sobre valores medidos de capa de hemirreducción por la introducción de grandes cantidades de substancia absorbente en la vía de un haz de rayos X de alta energía. Las variaciones en el valor medido de la calidad de dichos haces han resultado ser una función de la colimación y de la posición del absorbente para distancias fijas de la cámara focal.

Se investigó la variación en las determinaciones de la capa de hemirreducción para el haz de un generador de rayos X de 2 Mvp, sin filtración y con filtración a través de 1.0 y 5.0 mm. de plomo. Los absorbentes usados para estas determinaciones fueron colocados a 5.0, 53.5 y 95 cm. de distancia del foco.

Los resultados muestran una variación de 25 a 30 por ciento en los valores medidos cuando se usan los absorbentes en las posiciones indicadas.

Multiple Simultaneous Body-Section Radiography[1]

ELLIOTT C. LASSER, M.D., and EDWARD L. NOWAK, R. T.

BODY-SECTION radiography (planigraphy, laminagraphy) has earned for itself a place of importance in the field of diagnostic radiology. It should no longer be viewed as merely a device for refinement of conventional radiographic exploration, but rather as a separate and unique approach to the study of the part in question.

In utilizing this procedure, however, two major considerations become evident. It is time-consuming, and it may expose the patient to considerable amounts of radiation. Both of these obstacles have been in large part obviated by the development of a method whereby multiple planes of predetermined separation may be obtained simultaneously in a single exposure.

This method of multiple simultaneous body-section radiography was developed in theory by Ziedses des Plantes (1) in 1933. It was undertaken practically by de Abreu (2) in 1947 and later by Watson (3), Sennott (4) and others. It has received sporadic acceptance thus far in this country. The present report is designed to review the theory underlying multiple simultaneous laminagraphy and to explain some of the modifications in conventional radiographic equipment that will enable this procedure to be carried out on a practical basis.

In conventional (single-section) laminagraphy only one body plane will be projected in a stationary fashion on the film throughout the course of its travel. As the tube and film move in opposite directions, one, and only one, body plane travels at precisely the same speed as the film. Planes above and below this level, which is coincident with the fulcrum of the connecting axis, travel faster and slower, respectively, than the plane of interest and, therefore, do not present a recognizable image on the film.

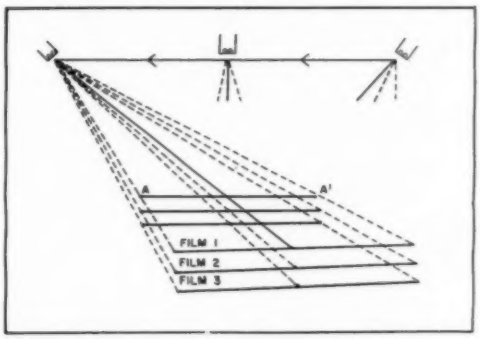


Fig. 1. Diagrammatic representation of multiple simultaneous laminagraphy.

Reference to Figure 1 will show that when a vertical stack of films separated by suitable spacings is substituted for the usual single film, images that move too slowly for the top film may move with precisely the right speed for lower-level films. Thus, a number of separate planigraphic images rather than a single planigraphic image can be recorded by a single tube-film movement. Reference to Figure 1 again will show that if the fulcrum lies at level A-A′, this planigraphic image will be registered on Film 1. An imaginary fulcrum, however, may be considered to exist for body sections below this level, and each of these lower planes, the separation of which will be dependent upon the film separation, will cast an image on its corresponding film. The separation of body planes will not be identical with the separation of the films, but will depend on the tube-film distance and the height of the fulcrum. Thus, if the fulcrum is 10 cm. from the top film and a 40-inch tube-film distance is used, films separated from one another by 0.625 cm. will record body planes 0.56 cm. apart. If the fulcrum is placed at a level higher than 10 cm. from the film, the body plane spacings are

[1] From the Department of Diagnostic Radiology, Roswell Park Memorial Institute, Buffalo, N. Y. Accepted for publication in April 1955.

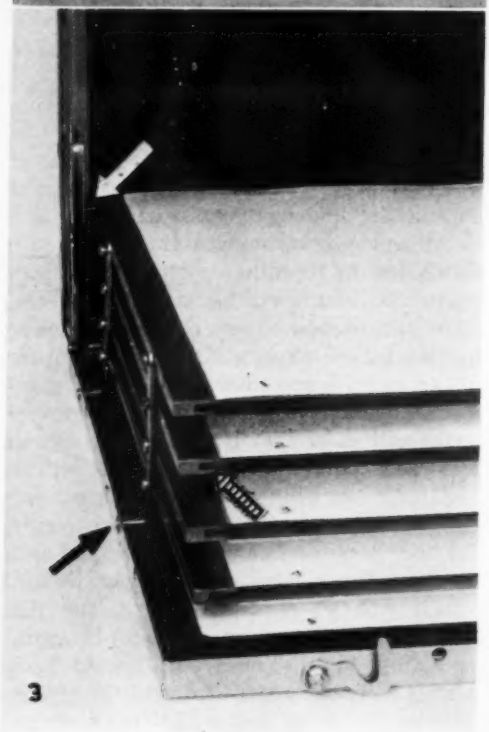


Fig. 2. Lateral view of Roswell Park multifilm cassette.

Fig. 3. Detail frontal projection of cassette. Striped arrow indicates keyway slot in brass holder. Black arrow points to pivot spacer mounted in lateral wall of cassette. White arrow indicates metal spacer attached to top film layer and riding in slotted plate attached to top of cassette.

slightly reduced. They will be slightly increased if the fulcrum is at a level below 10 cm. For practical purposes, these minor differences have no significance.

In a multiple-film magazine of the type suggested above, two considerations must be borne in mind; all things being equal, lower films cannot be expected to maintain an equal radiographic density with higher films, since there are both absorption from the higher films, screens, and spacers, and a fall off in radiation due to the inverse-square law. The diminished intensity of radiation on the lower films can be compensated for by employing suitable combinations of intensifying screens of various speeds, by using films of varying speeds, by suitable masking of intensifying screens, or by controlled development of the individual films. Any one of these factors or a combination of them may suffice to produce films of a relatively uniform density.

At the Roswell Park Memorial Institute, a cassette has been devised for handling five films separated by 1/4 inch spacings (Figs. 2–4). This special cassette, which was constructed in the Institute's own machine shop, was based on the detailed specifications of one of the authors (E. L. N.). It has the advantage over other multifilm cassettes that the Lucite spacings and the corresponding intensifying screens are automatically separated on opening the cassette and are automatically reapproximated upon closing it. This greatly simplifies the loading and unloading of the film magazine.

Reference to Figure 2 shows the main structural characteristics of the Roswell Park cassette. It is designed for a 10 × 12-inch film and in the closed position is 1 11/16 inches deep. Each of the Lucite plates is mounted laterally in a brass holder with a keyway slot (Fig. 3, striped arrow). The brass holders are connected with one another by two metal armatures on each side (Fig. 2). The lower end of each of these pivots about a small metal spacer mounted in the lower wall of the cassette (Fig. 3, black arrow). When the cassette is open, each Lucite layer with its accompanying intensifying screen or screens is slightly recessed over the layer below. On closing the cassette, there is automatic realignment of all levels. The

posterior portion of the topmost layer is attached by a small cylindrical metal spacer to a slotted plate mounted, in a vertical position, in the rear of the cassette (Fig. 3, white arrow). This arrangement allows for automatic separation of the layers on opening the cassette.

The entire magazine was fashioned from an ordinary 10 × 12-inch cassette disassembled and built up in depth. Having undergone this additional separation, the upper and lower covers of the cassette were reapproximated in their posterior portions by a long piano hinge. Because the top and bottom portions of the ordinary cassette were reversed, rigid metal restricting levers (Fig. 4) were added to prevent the floor of the cassette from pressing upward when the magazine was opened. These are released when the cassette is closed in use.

The film-screen combination employed in this cassette is as follows: No. 1 film lies over a single detail Patterson screen; No. 2 film lies over a single detail Patterson screen. No. 3 film lies over a single Patterson Par Speed screen. No. 4 and No. 5 films lie between Par Speed and slow Patterson screens. Eastman Kodak Blue Brand films are used at levels 1, 2, and 5. Dupont Par Speed films are used at levels 3 and 4. No masking is necessary, and development is constant for all films. The above scheme was compounded largely by trial and error, and there is little doubt that it can be improved upon. The present arrangement generally allows good uniformity but is partially wave-length dependent. Using Lucite spacers and the film-screen arrangement noted above, only 13.1 per cent of the radiation impinging on film 1 falls on film 5. About 8 per cent of

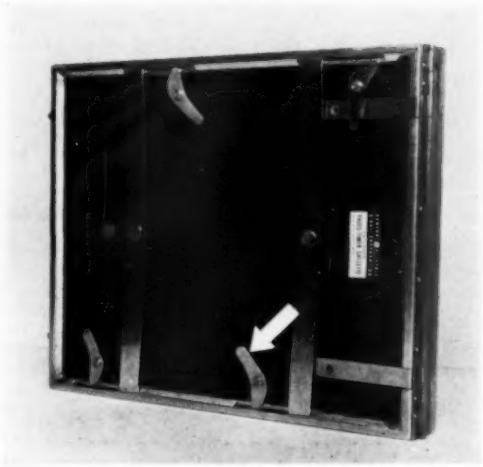


Fig. 4. Cassette seen from below. Arrow points to restricting lever in closed position.

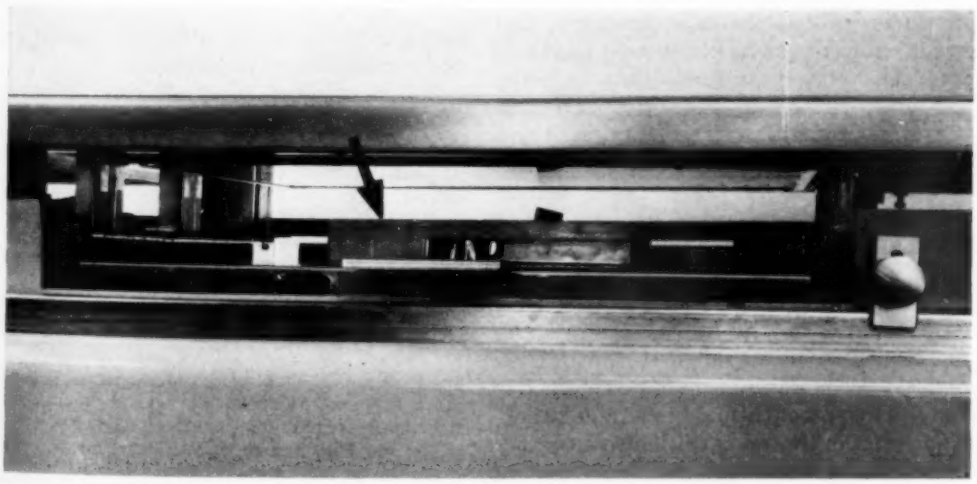


Fig. 5. Arrow indicates special cassette in place in altered Bucky slot.

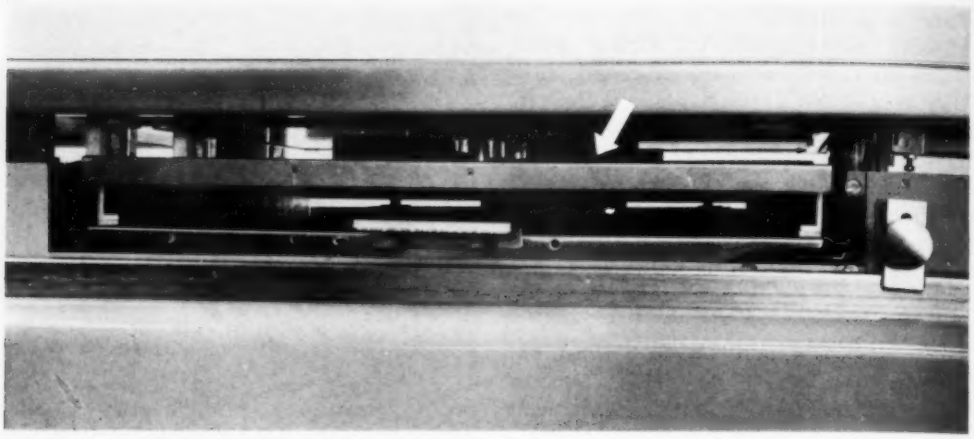


Fig. 6. Arrow indicates raised Bucky tray used when conventional (single-plane) laminagraphy is desired.

this loss is due to increased distance, the bulk of the reduction being due to intervening screens and films.

To simplify further the procedure of obtaining multiple simultaneous laminagrams, certain alterations were also necessary in the radiographic table. Under ordinary circumstances, the clearance between the surface of the Bucky tray and the undersurface of the table top is insufficient to accommodate a film magazine of the dimensions mentioned above. If a conventional radiographic tilt table is being utilized, it has previously been found necessary to approach the Bucky tray from its undersurface. In most instances, this has been accomplished by tilting the table into the vertical position, thus exposing the undersurface of the tray. To simplify the process in our installation, it was decided to raise the table top to provide sufficient clearance. This was accomplished by adding a 1 1/2-inch support to the table top at each end and altering the Bucky tray carriage in such a fashion that it still mounted snugly in its track on the undersurface of the table. The Bucky diaphragm was also raised so that a total of 2 3/4-inch clearance could be obtained in the Bucky slot of the modified table in contradistinction to the usual 1-inch clearance on similar models (Fig. 5). In order that conventional laminagraphy could be carried out on the same table, a second Bucky tray was constructed in which the carrying surface was elevated to a normal position in relation to the undersurface (Fig. 6).

With the apparatus described above, multiple simultaneous laminagrams of body planes approximately 0.5 cm. apart have been obtained with ease and rapidity. Increasing our experience with this method will further define its indications and limitations.

SUMMARY

1. Multiple simultaneous laminagraphy has proved to be an efficient method of body-section roentgenography.

2. A method of modifying existing radiographic equipment to carry out this procedure with ease and dispatch has been described.

ACKNOWLEDGMENT: The authors gratefully acknowledge the co-operation of the General Electric Company in modifying the radiographic table and the Bucky carriage and trays. Acknowledgment is also made to Mr. Joseph Koperski, principal x-ray technician at the Roswell Park Memorial Institute, who worked out the intensifying screen arrangement, and to Mr. Carl Wahl of the Maintenance Department of the Institute, who undertook the actual construction of the multifilm cassette. Acknowledgment is also due Dr. Norman A. Baily and Mr. Norman Beyer for the absorption determinations.

REFERENCES

1. ZIEDSES DES PLANTES, B. G.: Planigraphie. Fortschr. a. d. Geb. d. Röntgenstrahlen **47**: 407–411, April 1933.
2. DE ABREU, M.: Theory and Technique of Simultaneous Tomography. Am. J. Roentgenol. **60**: 668–674, November 1948.
3. WATSON, W.: Simultaneous Multisection Radiography. In Modern Trends in Diagnostic Radiology, edited by T. W. McLaren, Second Series, New York, Paul B. Hoeber, Inc., 1953.
4. SENNOTT, W. M., AND WORRELL, H. E.: Multifilm Cassette For Use in Laminagraphy. Am. J. Roentgenol. **70**: 141–142, July 1953.
5. BAUDRY, S.: Use of Photographic Masks for Making Simultaneous Tomograms. M. Radiog. & Photog. **26**: 54–56, 1950.

Department of Diagnostic Radiology
Roswell Park Memorial Institute
Buffalo 3, N. Y.

SUMARIO

Radiografía Múltiple Simultánea de Secciones del Cuerpo

Descríbese aquí un método de roentgenografía múltiple simultánea de secciones del cuerpo que puede llevarse a cabo con el instrumental radiográfico corriente, debidamente modificado. El procedimiento comprende el empleo de un chasis que tenga espacio para cuatro radiografías separadas por espaciadores de 6.25 mm. de Lucita. Este se construye de un chasis corriente de 25 x 30 cm., desmontado y extendido en profundidad. Cerrado, tiene unos 42 mm. de hondo. Los espaciadores de Lucita y las correspondientes pantallas intensificadoras se separan automáticamente al abrir el chasis y se reaproximan también automáticamente al cerrarlo.

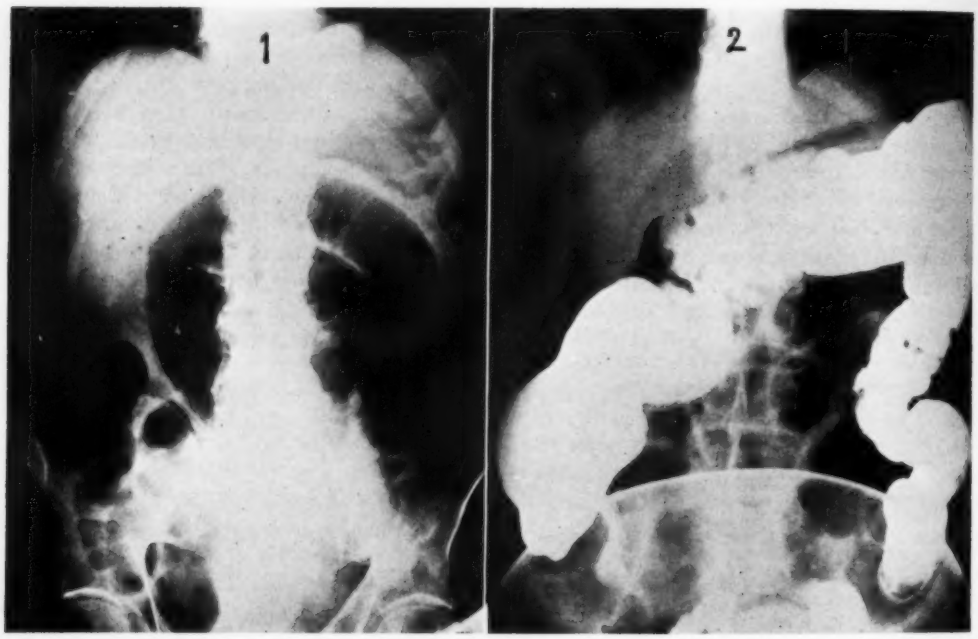
Para acomodar una cámara de películas de tales proporciones, se modificó la mesa de radiografía elevando la porción superior mediante la adición de soportes en ambos extremos. También se elevó el diafragma de Bucky y se construyó otra bandeja de Bucky a fin de poder seguir usando la misma mesa para la laminagrafía corriente.

A Note on Barium Enema Examination of Incontinent Patients[1]

S. W. WESTING, M.D.

SINCE THE occluding rectal catheter came into use, barium enemas can be administered to patients who heretofore were unfit for this procedure because of diminished sphincter function. Occasionally, however, patients are encountered whose anal incontinence and lack of cooperation which would contraindicate barium by mouth. When speed is of the essence and when obstruction is either known or suspected to exist, one may be tempted to consider the contemplated colon study impossible.

In such a situation the examination may

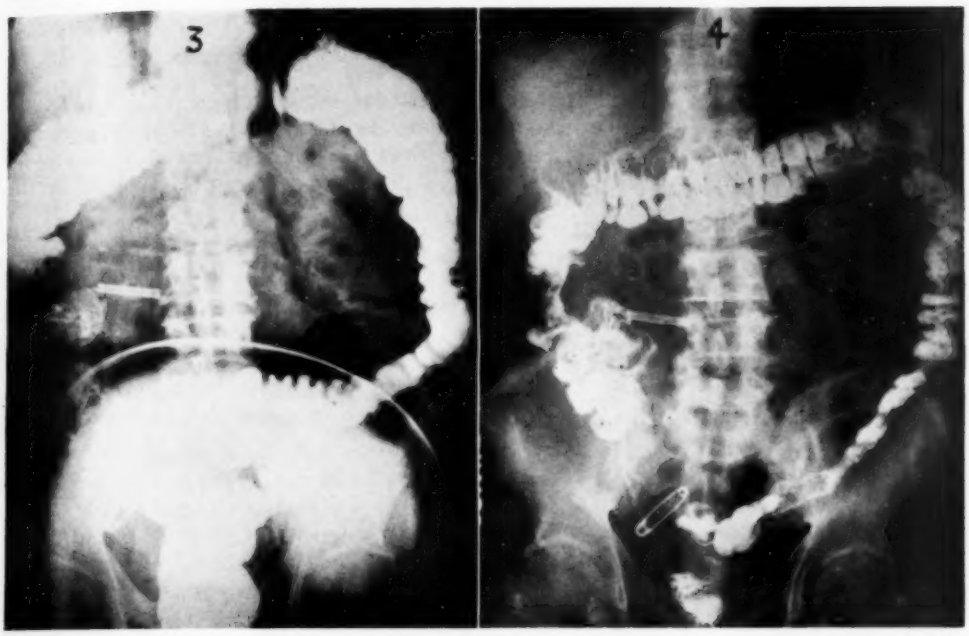


Figs. 1 and 2. Case I. 1. Film of the abdomen showing organic obstruction within the small intestine. 2. Barium enema study with the patient lying on the aluminum bedpan. The examination ruled the colon out as the seat of obstruction. Note the abnormal appearance of the terminal ileum. This is a verified case of organic obstruction within the small intestine caused by histologically proved regional enteritis.

are so great that, despite the occluding catheter, the enema fluid is expelled prematurely. In these circumstances, demonstration of the lower intestinal tract may be achieved with the help of a barium meal and at least part of the information expected from the enema study may be obtained, provided time is available for the meal to reach the lower intestine and provided further that there is no obstruction, be carried out as planned by the simple expedient of placing the patient on a bedpan, through which the rays are allowed to pass. Although most bedpans are made of steel, the metal interferes surprisingly little with the visibility. The results are even better when an aluminum bedpan is used, as this is nearly invisible roentgenologically.

While the patient responds to the urge

[1] From the Radiological Service of the Veterans Administration Hospital, Newington, Conn. Accepted for publication in February 1955.



Figs. 3 and 4. Case II. 3. After emergency operation for perforation of the cecum, a barium enema study with the patient lying on the aluminum bedpan revealed the heretofore unknown affection of the ascending colon. Note collection of barium suspension in the bedpan.

4. Film taken following partial evacuation and after removal of the bedpan. This is a verified instance of a napkin-ring type of constriction of the ascending colon; histologically proved adenocarcinoma.

to expel the fluid, the enema flow is kept up. In the majority of the cases, the barium suspension can be pushed up as far as the cecum and often into the terminal ileum before the amount expelled fills the bedpan to capacity. The examination done in this manner requires a slight modification of the customary procedure because, first, it is not possible to rotate the patient as long as he is lying on the bedpan and, secondly, the opaque fluid which collects in the bedpan may, after a while, partly obscure the image of the lower intestine. As soon as the urge to evacuate has subsided and the bedpan has been removed, the residual barium in the colon and terminal ileum is seen in an unobstructed view and the patient can be rotated into any of the positions desired for proper fluoroscoping and filming. Thus the examination can be concluded without any sacrifice of accuracy.

The aluminum bedpan has been used by us for a number of years[2] and has enabled us to carry out successful colon studies in many otherwise unexaminable cases. The method relieves the roentgenologists, technicians, and patients of anxiety and obviates many unpleasant disturbances.

The accompanying illustrations represent two examples of the usefulness of the technic.

SUMMARY

When anal sphincter control is so reduced that not even by the use of the occluding rectal catheter can retention of an enema be obtained, a barium enema study can still be accomplished with the patient on a bedpan, preferably one of aluminum.

43 Arnold Way
West Hartford 7, Conn.

[2]Our bedpan is manufactured by the Wear-Ever Aluminum Company, New Kensington, Penna.

SUMARIO

Nota Relativa al Examen con Enema de Bario de los Enfermos de Incontinencia Fecal

Cuando el dominio del esfínter anal está tan reducido que, ni aun usando una sonda rectal oclusiva, cabe garantizar la retención de una enema, todavía puede llevarse a cabo un estudio con enema de bario, colocando al enfermo en la chata. Para esto, se prefiere un orinal de aluminio, que es invisible roentgenológicamente.

Criteria for Evaluating Gamma Radiation Exposures from Fallout Following Nuclear Detonations[1]

GORDON M. DUNNING[2]

THE RADIATION factor of greatest immediate concern to man in the fallout incident to nuclear detonations is the external gamma radiation emitted from material after deposition on the ground. This is the only factor that will be discussed here.

COMPARATIVE RADIATION DOSES AND BIOLOGICAL EFFECTS

In evaluating the biological effects of gamma radiation exposures from fallout, it is natural to turn to the many experiments that have been performed in the laboratory. In making a comparison, however, certain differences between the two sets of conditions necessitate consideration.

First, in the laboratory, narrow-beam exposures, unilateral or bilateral, have been the rule, while radiation from a fallout field may represent a source in radial geometry, *i.e.*, the radiations reach a given point from material which is spread over a plane. A usual laboratory method is to measure the air dose rate from a unilateral or bilateral source at the proximal surface of the subject, and to report the dose required to produce a given biological effect. For larger animals this dose may be significantly higher than one calculated by integration of the air dose all around the subject, which, in essence, is the situation when an air dose rate measurement is taken in a fallout field. Thus, biological effects comparable to unilateral and bilateral exposures may be produced by lower air doses as measured in a fallout field.

This geometry factor has been shown to have genuine significance for large animals, such as swine, where the LD 50/30 values (the instantaneous dose of radiation that will cause one-half of the animals to die within thirty days) decreased from 500 to 350 or 400 r when the method of exposure was changed from unilateral to bilateral (1). Still further reductions might be expected in changing to exposure from a source in radial geometry.

Second, an experiment with *Rhesus* monkeys (2) in which 250-kvp x-rays were used gave an LD 50/30 value of 530 r. A significant number of the monkeys died, however, after the thirtieth day. If the survival data at one hundred days (the extent of the data reported) were utilized, the figure (LD 50/100) might be close to 430 r. While it is proper to report and use LD 50/30 values for experimental purposes, such values are less relevant in the present study, since we are concerned with the general health and welfare of the public. It is as serious for a man to die on the one-hundredth day as on the thirtieth day.

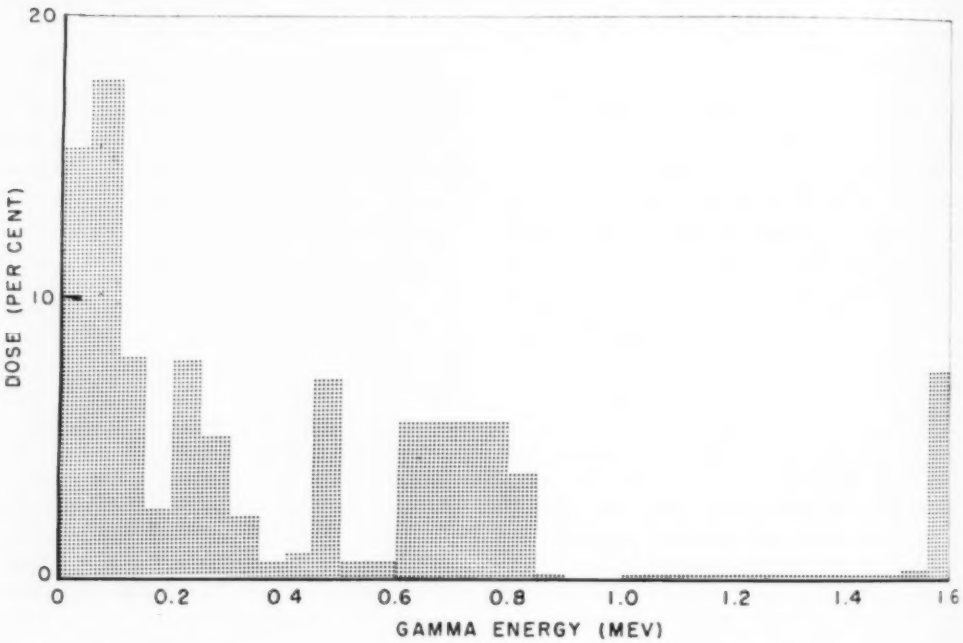
That the factor of deaths after thirty days may be extrapolated from one primate to another is suggested by the Japanese data (3). In the group sampled for Hiroshima, the number of reported deaths between the twentieth and twenty-ninth day was 137; for Nagasaki the figure was 87. After the twenty-ninth day 117 deaths were reported at Hiroshima and 87 at Nagasaki. (There were, of course, many deaths in these sampled populations *before* the twentieth day.) The difficult task of accurately recording, isolating, and identifying the causes of these deaths is recognized, but an analysis of the extent of radiation injury and the time of death would strongly indicate that radiation was a major factor in a significant number of the fatalities occurring after the thirtieth day.

The final difference between laboratory exposures and doses from fallout requiring

[1] Presented at the Forty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 11–16, 1955.

[2] Health Physicist, Division of Biology and Medicine, U. S. Atomic Energy Commission, Washington, D. C.

consideration is the energy spectrum of the radiation. The gamma spectrum emanating from fallout material is complex. In Graph 1 is shown the gamma spectrum for fallout after the detonation of March 1, 1954, at the Pacific Proving Ground (4), with the estimated percentage contributions of the gamma quanta of differing energies (million electron volts). It is recognized that such spectra may vary and that any single value may conceal important features, but an estimate of 0.7 Mev mean energy has been quoted as a first approximation (5).



Graph 1. Percentage of total dose contributed by gamma quanta energies shown (million electron volts).

WEATHERING AND SHIELDING

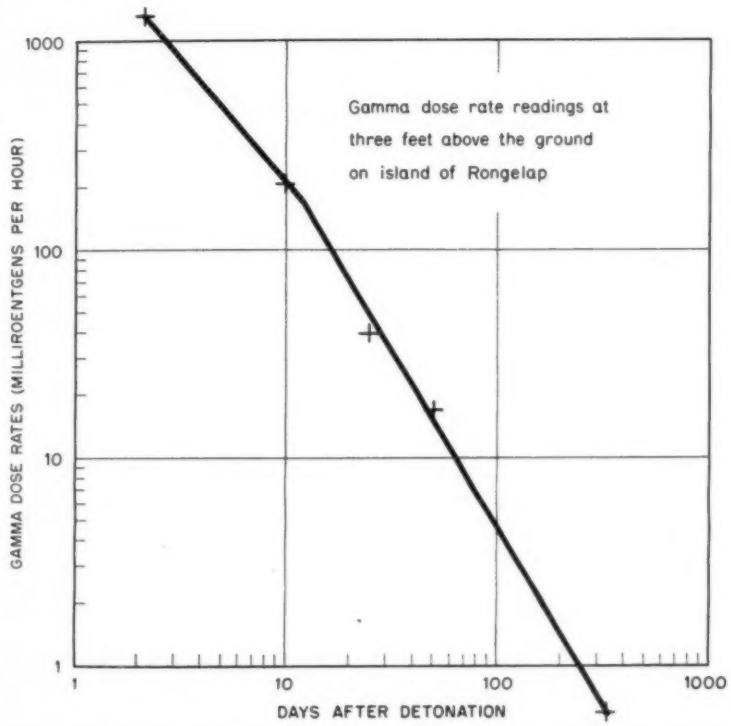
The variable nature of the two parameters of weathering and shielding makes establishment of a precise rule, covering all situations, impossible; yet these factors are operative in determining the total exposure received from fallout.

One example will be used here to give some perspective as to weathering effects. After the detonation on March 1, 1954, in the Pacific Islands, the winds were light and the first rainfall did not occur until about two weeks later. Graph 2 shows the gamma dose rates taken at 3 feet above the ground on the island of Rongelap over a period of nearly a year. In the first ten days the decrease in activity, or disintegrations per unit time, is roughly consistent with the known radiological decay rate for fallout material, *i.e.*, a slope of minus 1.2. The break between the tenth and twenty-fifth day, therefore, undoubtedly represents the effects of rain (and possibly winds), which was known to have occurred. The rest of the points fall roughly on a line of $(\text{time})^{-1.7}$, reflecting principally the effects of weathering and possibly, to a smaller degree, the fact that the number of gamma *quanta* released per disintegration decreases after the first thirty to forty days. In employing these data, however, one is faced with the problem of translating the effects from a Pacific island to larger land areas with different climatic conditions.

Neither the exact time of winds and rains nor the precise extent of dose-rate reduction can be predicted. These two parameters are obviously quanta events to which a straight line function may be ascribed only by the process of generalization, as in Graph 2. The following estimates may be proposed: For the first week following fallout, the measured gamma activity is assumed to decay according to $(t)^{-1.2}$, for the second week $(t)^{-1.3}$, and for the third week and thereafter $(t)^{-1.4}$. Justification for such values lies not in the high probability that they will occur at these times but rather in the necessity of generalizing (probably conservatively) in advance, so that some estimate of the parameter of weathering may be incorporated into evaluations of possible future contamination.

TABLE I: ESTIMATED ATTENUATION FACTORS OF GAMMA DOSE RATES FROM FALLOUT

Structure	*Approximate Factor*
Frame House	
First floor	2
Basement (center)	10
Basement (side)	>10
Multistory Reinforced Concrete	
Lower floors (away from windows)	10
Basement	~1,000
Shelter (equivalent of 3 feet of earth)	~1,000

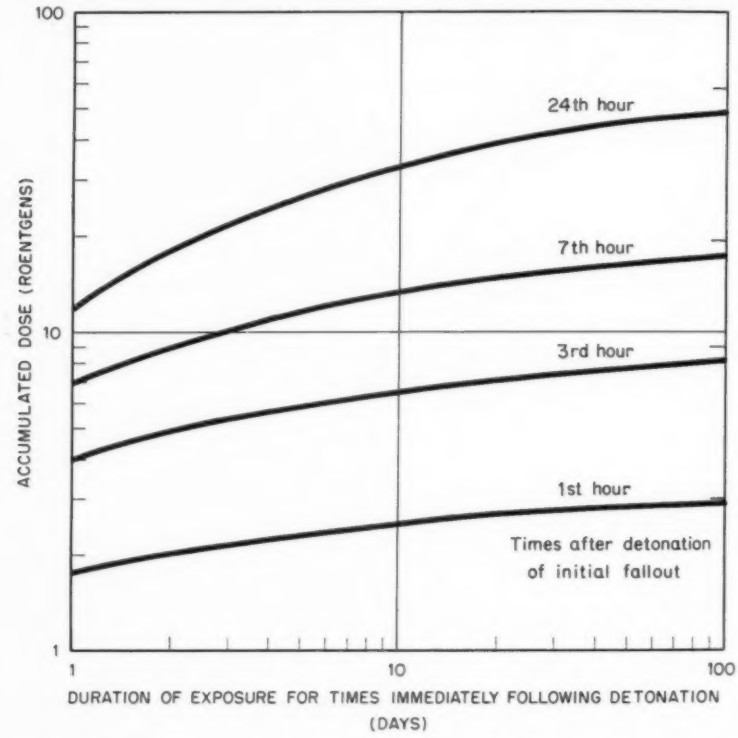


Graph 2. Gamma dose rates on the island of Rongelap following detonation of March 1, 1954.

Field measurements, as well as calculations, have indicated the attenuation of gamma dose rates to be expected from the shielding afforded by various structures. Obviously, there will be wide differences in this respect, depending upon the type and size of the structures; Table I gives some rough estimates of this factor of shielding. For the moment, let us consider a situation in which no special evasive measures are taken and people continue to live normally in the contaminated environment. Great variation in the amount of

accumulated radiation dose may be observed, dependent upon the location of personnel in relation to different types of buildings or natural terrain features and on the length of stay at a particular place.

During the 1955 nuclear test series at the Nevada Test Site, a number of film badges were placed outside and inside school buildings. The ratios of out-of-door to indoor doses ranged from 1.3 to 7. As anticipated, one-room frame buildings generally provided the least protection, with multiroom single-story concrete block buildings falling within the upper range of values. Since the duration of the exposures was generally less than one week, the effect was undoubtedly due principally to shielding rather than to weathering effects. Limited data were also collected for personnel—school teachers, physicians, mechanics, and others—wearing film badges as they went about their normal activities in adjacent communities. Out-of-door radiation doses were calculated on the basis of the survey data of monitoring teams shortly after fallout (as would be done in emergency situations); these were later compared with the doses indicated on the personnel film badges. The ratio of doses measured on film badges to those calculated for out-of-doors generally fell between 0.4 and 0.5. Duration of exposure ranged from two to three weeks.

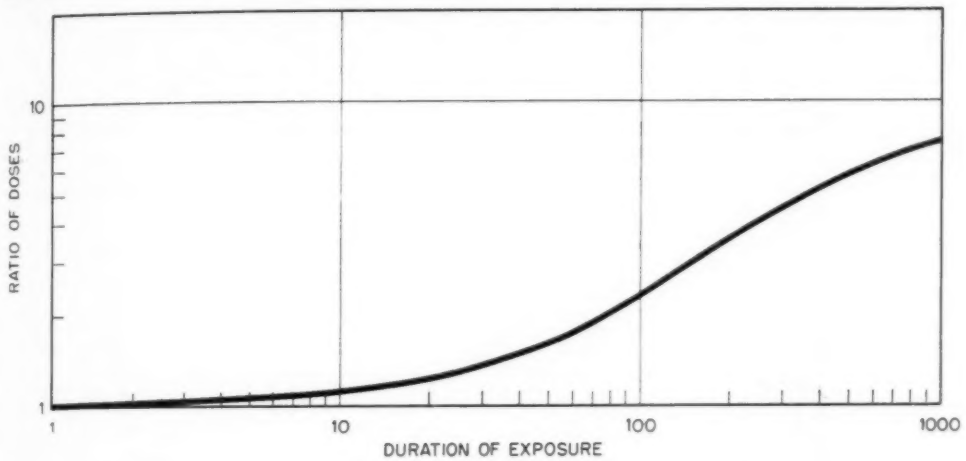


Graph 3. Estimated average accumulated gamma radiation doses for personnel continuing to live normally in a contaminated area, based on a dose rate of 1 r per hour at time of fallout. See text for assumptions.

On the basis of these data the dose with shielding during normal occupancy of an area may be conservatively estimated at 25 per cent less than that received by persons fully exposed for twenty-four hours each day.

One may combine the assumptions made for weathering and shielding and arrive at a family of curves which estimate the

accumulated radiation dose for persons living normally in a contaminated area (Graph 3). Since Graph 3 is based on an assumed dose rate of 1 r per hour at the time of fallout, the accumulated doses may be linearly extrapolated to any other dose rate at fallout. For example, if fallout begins at three hours after detonation and the dose rate at that time is 10 r per hour, then about 90 r might be accumulated by personnel continuing to live normally in the contaminated area.



Graph 4. Ratio of total accumulated equally fractionated daily gamma whole-body doses to a one-day exposure to produce the same whole-body effects.

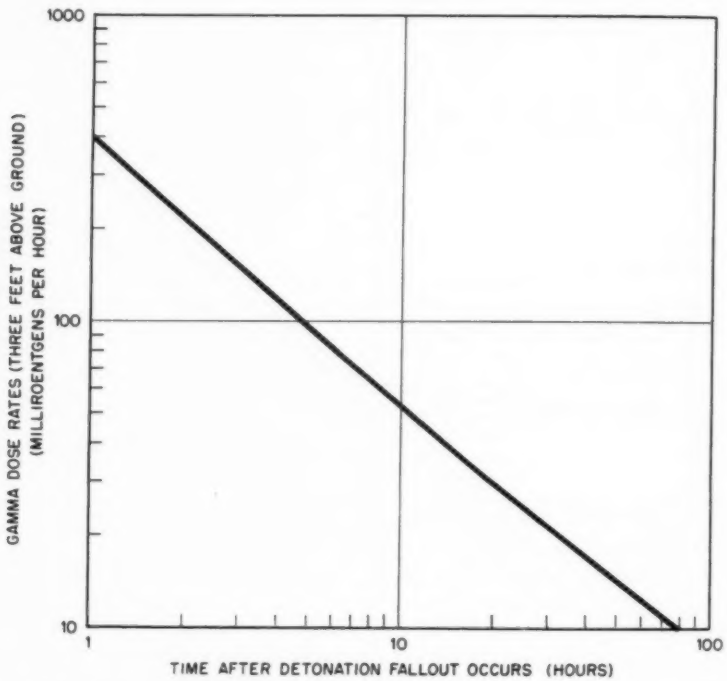
TIMED DOSES AND BIOLOGICAL EFFECTS

It has been recognized that, in general, the longer the period over which a given radiation dose is delivered, the less is the resultant biological effect, except for such aspects as the genetic. Since past experiments usually have been designed for other purposes, the data from these do not readily elucidate the rate of repair or the proportions of reparable and irreparable damage resulting from differently timed doses. Varying relationships have been demonstrated, depending upon the species or even the strain of animal, as well as the criteria selected for study, such as skin damage, life shortening, and LD 50 values. Our present knowledge does not permit establishment of a precise overall relationship for timed doses *versus* biological effects; yet there are sufficient convincing data to permit an attempt at estimating the effect of this phenomenon.

Blair (6, 7,) Smith (8), Davidson (9), and others have made extensive analyses of existing data on the effects of time-spaced doses for several species of animals. Generally, the recovery rate for larger mammals, such as dogs, is significantly less than for mice. One estimate places the half-time recovery for man at four weeks (9). The most conservative estimate of the effect of time-spacing of doses, for application to the problems under discussion, is that of Davidson. On the basis of his analysis, a plot has been constructed (Graph 4) of accumulated, equally fractionated daily doses *versus* an acute exposure which would result in the same whole-body effect (death or sickness). This analysis indicates, for example, that if a radiation exposure is divided into equal daily doses, the total amount accumulated over eighty days would be twice the amount required by a one-day exposure to produce death or sickness.

The calculations necessary to incorporate the factor of timed doses into those for radiological decay, weathering, and shielding are rather tedious. An approximation

may be made merely by superimposing Graph 4 on Graph 3; the point where the curves become tangential is the point of maximum effect to be expected from doses accumulated from fallout. It is not intended to imply that no further radiation damage is received from exposure after that time. Rather, the analysis does indicate that if the accumulated dose from fallout up to the time of tangency is not sufficient to produce death or radiation sickness, than (*a*) the rate of repair (for the reparable portion of the dose received) will exceed the rate of exposure thereafter, and, of course, (*b*) the irreparable fraction of the total dose for the duration of the fallout will be insufficient to produce these whole-body effects. It is recognized that the rates of dose accumulation as calculated by the two methods (Graphs 3 and 4) are not identical, since a larger proportion of the total dose accrues from fallout during the first part of the exposure period. This more rapid rate of delivery might increase the percentage of irreparable damage to some extent. On the other hand, a greater proportion of the biological damage would occur early in the exposure period, allowing a longer time for the reparable factor to operate before the curves become tangential. The radiation status for the reparable fraction of the damage is thus better at the time of tangency. Until more definitive data are obtained, this analysis may serve to approximate the biological repair factor.



Graph 5. Approximate gamma dose rates at time of fallout to produce an estimated effective biological dose of 1 r for personnel continuing to live normally in a contaminated area. See text for assumptions.

Graph 5 incorporates into a single curve the major effects due to weathering, shielding, and biological repair. The radiation dose arrived at by these calculations is called the "effective biological dose." As in the previous graph, the accumulated

TABLE II: APPROXIMATE AREAS ENCOMPASSED BY THE EFFECTIVE BIOLOGICAL ISODOSE LINES SHOWN IN THE MAP (FIG. 1)

Isodose Line (*r*)	*Approximate Areas Encompassed* (*square miles*)
50	25,000
100	12,500
400	5,000

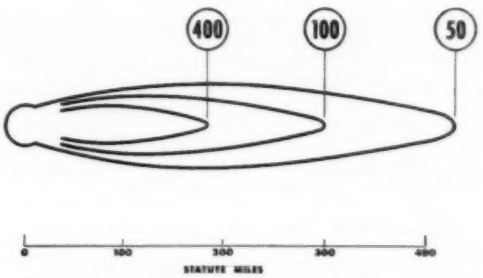


Fig. 1. Idealized fallout diagram, based on high-yield nuclear detonation of March 4, 1954. Isodose lines represent effective biological doses (roentgens).

doses may be extrapolated linearly to any other dose rate at time of fallout. For example, if fallout begins three hours after detonation and the dose rate at that time is 10 r per hour, about 67 r (effective biological dose) will be accumulated provided personnel continues to live normally in the contaminated area.

$$\frac{10}{0.15} = 67$$

It is frankly recognized that in any single curve, such as that shown in Graph 5, there are inherent a number of uncertainties that are open to discussion. Criteria based on deliberate analyses of the relevant data, however, may be more valid than those determined under the duress of an emergency situation. Such a simplified graph might provide radiological monitors with a quick, even if rough, estimate of the potential hazards and thus assist in making decisions as to possible evacuation, etc.

FALLOUT PATTERN FROM HIGH-YIELD WEAPONS

From Graph 5 and data from other sources (10, 11), an idealized diagram of effective biological doses for fallout from the March 1, 1954, surface detonation at the Pacific Proving Ground has been prepared (Fig. 1). It is to be emphasized that (*a*) *different yields of weapons, different wind structures, and different kinds of land surface, would result in different patterns*, and that (*b*) *this is the amount of fallout from a single high-yield weapon.*

The two innermost isodose lines shown were selected to suggest regions where (*a*) a significant percentage of personnel might be expected to die (400 r) and (*b*) a few per cent to become ill (100 r), assuming continued occupancy of these areas with no special protective measures. These percentages would, of course, rise within the encompassed areas. The 50-r effective biological isodose line has no unique significance but suggests the magnitude of dose which might call for emergency measures against radiation exposures even in the face of other possible hazards. Table II shows the approximate areas encompassed by the three isodose lines. For areas where the fallout occurs a few hours or more following detonation, many days or weeks will be required to accumulate the major portion of effective biological doses, so that spot decisions involving additional hazards might not be necessary.

PROTECTIVE MEASURES

The idealized fallout diagram is based on the assumption that people continue to live normally in an area and that they do nothing special to protect themselves. Actually many measures can be taken to reduce the gamma radiation dose. These may be classified under four headings: 1. Evacuation. 2. Use of shielding. 3. Decontamination of the environs. 4. Allowing for lapses of time before entry into a contaminated area. These measures will be discussed only briefly.

Where relatively small numbers of people are involved, *evacuation* could be an easy solution. For large communities, major factors of danger and/or hardship must be considered. Each situation may be unique, and independent decisions must be

TABLE III: ESTIMATED REDUCTION IN GAMMA DOSE RATES AT THREE FEET ABOVE THE GROUND TO BE EXPECTED FROM VARIOUS DECONTAMINATION PROCEDURES ON LAND SURFACES*

Procedure	*Approximate Reduction Factor*
Plowing (to depth of 8 inches)	3
Bulldozing or grading (to depth of 4 inches)	4
Fill (clean dirt to depth of 6 inches)	5
Scraping (to depth of 4 inches, with concurrent removal of exhumed dirt)	10

* Based on data in Radiological Recovery of Fixed Military Installations (12).

made accordingly; it is not possible to establish beforehand any general rule of action based on radiological considerations alone. The complex factors entering into this problem cannot be discussed here. There is available, however, a considerable amount of data on the radiological aspects of fallout to aid civil defense authorities in making the decisions which will ultimately rest with them.

The amount of protection afforded by *shielding* is suggested in Table I. The exact dose rates that might be expected from a fallout cannot be predicted, but it appears reasonably certain that a shielding factor of 1,000 would, even in the areas of heavy fallout, reduce the radiation below levels which might produce sickness. Such a reduction might be attained by about 3 feet of earth or sand or 19 inches of concrete. Even the cellar of a frame house will reduce the dose rate by a factor of about 10, which might spell the difference between relative safety and the danger incident to full exposure. In the area of maximum contamination, however, located within the 400 r ellipse of the fallout diagram, a factor of 10 might not be enough to keep the accumulated dose below a hazardous level, even for a period of half a day following fallout; in that case more protective shelters or evacuation would be required.

The third measure that might be taken to reduce the radiation dose is *decontamination* of the environment after fallout has occurred. Table III, based on field data (12), indicates the degree of reduction in gamma dose rates at three feet above the ground which might be accomplished by various operations on the soil. Table IV gives reductions of contamination of surfaces as estimated by one method of determination. (For more extensive analyses see references 12, 13, and 14.)

The final factor of major benefit in reduction of radiation dose is the *lapse of time*. On the basis of radiological decay alone, the activity (disintegrations per minute) decreases approximately according to the principle of $(\text{time})^{-1.2}$. Thus, for every sevenfold lapse of time after a nuclear explosion, there will be a tenfold reduction in dose rate. For example, if fallout occurs one hour after a detonation, the dose rate will be one-tenth of its initial value by the seventh hour; an additional tenfold reduction would require about two additional days of waiting. Similarly, the total possible out-of-doors dose accumulated from the first to sixth hour after detonation would be approximately the same as that from the sixth hour until one week later. Further, this first-week dose would be about twice as great as the entire remaining dose possible for the lifetime of the activity, even in the absence of weathering. This rapid decay suggests the benefits of protection in the early periods after fallout and, where possible, delay of entry into a contaminated area.

TABLE IV: ESTIMATED REDUCTION IN CONTAMINATION OF SURFACES USING A FIRE HOSING METHOD*

Surface	*Approximate Reduction Factor*
Concrete	10
Wood	30
Metal	30
Roofing	30

* Based on a dry contaminant. For a slurry contaminant, the reduction factors might be only one-third as great. Pre-protection of wood and concrete surfaces, *e.g.*, with sealers or paints, might increase the reduction factor by a factor of about 3. (Based on data in Radiological Recovery of Fixed Military Installations (12)).

The question is frequently asked as to the time one must spend within a shelter or remain outside of a contaminated area. The answer depends upon a number of parameters, such as the criteria established

for maximum permissible dose, as well as length of stay within the area of contamination. With knowledge of the magnitude of the radiation levels present and the rate of decay, $(t)^{-1.2}$, it is possible to plan and execute a short stay even in a highly contaminated area. Planning for continuous occupancy requires more extensive analysis. The following data may aid in such evaluation.

The fallout map and Table II suggest the degree of radiation exposure received in continuous occupancy under normal living conditions beginning with the time of initial fallout. For those entering the contaminated zone four months after the first fallout, however, and then living there indefinitely, the area encompassed by the 50-r effective biological isodose line will have shrunk from about 25,000 to 2,500 square miles. At such time (four months after fallout), an area of about 1,000 square miles within the 50-r isodose line might have the highest residual contamination, amounting to about three times the dose rates at the periphery. The 0.3 r per week out-of-doors isodose-rate line might extend to about the same position as the line marked 50 on the map.

As one attempts to extrapolate such data to one year after fallout, the analysis becomes still more difficult and uncertain. The data suggest, however, that if return is postponed to one year after fallout, the 50-r effective biological isodose line will have disappeared. On the basis of these conservative estimates, the 1,000 square miles of highest contamination might have an out-of-doors dose rate of about 4 r per week after one year. Similarly, personnel might accumulate a dose of about 100 r for the first year following exposure and an additional 90 r over the next three years, independent of the biological recovery factor. It is to be expected that this factor would be relatively great for such long periods of time, thus reducing the effective biological dose below 50 r. The 0.3 r per week out-of-doors isodose-rate line might encompass an area somewhat larger than the line marked 400 on the map. (The weathering factor for the islands in the Pacific has been greater than the assumed value for large land masses, so that at one year the out-of-doors dose rate on these islands was less, by a factor of almost 2, than would be predicted by the method suggested here.)

The foregoing analyses are based on passive factors only, not taking into account the actions of persons themselves in reducing contamination. If, for example, a permanent return into an area were postponed for one year after fallout, the radiological situation would probably have been adequately appraised, and decontamination operations initiated. Moreover, with the return of a populace into a known contaminated area, more than normal precautions might be expected in regard to occupancy of the more protective types of buildings and reduction of time spent out-of-doors.

It appears not unreasonable to assume that the theoretical out-of-doors dose rates for the areas of highest residual contamination, calculated by means of the extrapolations given above, actually might be many times reduced. The data thus suggest that, with this type of detonation, continual occupancy even of the most heavily contaminated area need be prohibited for only about one year.

The task of evaluating radiation exposures from fallout is fraught with uncertainties, and one instinctively shrinks from proposing criteria based on such variables and intangibles. Yet we would be doing ourselves a disservice if we did not attempt an analysis of the relevant factors and incorporate them into some conceptual scheme as indicated here. The analytical approaches, and certainly the quantitative values suggested, are not to be considered precise but are intended, rather, to give order-of-magnitude estimates. It is believed that they are, in general, conservative, *i.e.*, they do not underestimate the potential hazards involved.

Division of Biology and Medicine
U. S. Atomic Energy Commission
Washington, D. C.

REFERENCES

1. TULLIS, J. L., CHAMBERS, F. W., JR., MORGAN, J. E., AND ZELLER, J. H.: Mortality in Swine and Dose Distribution Studies in Phantoms Exposed to Supervoltage Roentgen Radiation. Am. J. Roentgenol. **67:** 620–627, April 1952.
2. HENSCHKE, U. K., AND MORTON, J. L.: Mortality of Rhesus Monkeys After Total Body Irradiation. Work performed at the Ohio State University Medical Center. To be published.
3. Medical Effects of Atomic Bombs. Oak Ridge, Tenn., U. S. Atomic Energy Commission, Technical Information Service, April 19, 1951, Vol. 5, pp. 279 and 283, Tables 58 and 62.
4. Work performed by Mr. Charles Sondhaus, formerly at U. S. Naval Radiological Defense Laboratory, San Francisco, Calif.
5. Effects of Atomic Weapons. Superintendent of Documents, U. S. Government Printing Office, 1951.
6. BLAIR, H. A.: A Formulation of the Injury, Life Span, Dose Relations for Ionizing Radiations. I. Application to the Mouse. University of Rochester. UR-206, May 1952.
7. BLAIR, H. A.: A Formulation of the Injury, Life Span, Dose Relations for Ionizing Radiations. II. Application to the Guinea Pig, Rat, and Dog. University of Rochester. UR-207, July 1952.
8. Analysis of Animal Whole-Body Irradiation Data. Armed Forces Special Weapons Project-496. Silver Spring, Md., Smith, E. F., & Co., undated.
9. Work performed by Dr. Harold Davidson, Operations Research Office, The Johns Hopkins University, Bethesda, Md.
10. The Effects of High-Yield Nuclear Explosions. Statement by Lewis L. Strauss, Chairman, and a Report from the A. E. C. Feb. 15, 1955.
11. LIBBY, W. F.: The Atomic Energy Commission and National Security. Remarks at Washington Conference of Mayors, Washington, D. C., Dec. 2, 1954; Radioactive Fallout. Remarks at Alumni Reunion, University of Chicago, June 3, 1955. The Radioactive Fallout. Remarks at Fourth Annual Conference of the U. S. Civil Defense Council, Boston, Mass., Sept. 29, 1955.
12. Radiological Recovery of Fixed Military Installations. U. S. Naval Radiological Defense Laboratory, San Francisco, Calif., August 1953.
13. BRESLIN, A. J., AND SOLON, L. R.: Fallout Countermeasures for AEC Facilities: A Preliminary Report. Atomic Energy Commission Health and Safety Laboratory, New York, December 1955.
14. DUNNING, G. M.: Immediate Hazards from Radioactive Fallout and Some Countermeasures. Remarks at Security Meeting of the Standard Oil Company of New Jersey, Houston, Tex., Feb. 15, 1956.

SUMARIO

Pautas para Justipreciar las Exposiciones a las Radiaciones Gamma Procedentes del Desprendimiento Consecutivo a las Detonaciones Nucleares

Repásase aquí el problema de la radiación gamma externa emitida después de depositarse en la tierra el material lanzado.

Las exposiciones a la radiación procedente de un campo de desprendimiento discrepan de la mayor parte de los experimentos de laboratorio con respecto a la geometría y al espectro de energía, lo cual hay que tomar en cuenta al valuar los efectos biológicos. Además del factor de decadencia radiológica, los efectos se ven afectados por la exposición al aire, el resguardo (como por edificios y terreno) y el tiempo de la dosis. Utilizando estos factores, se ofrece un diagrama idealizado de desprendimiento para una explosión superficial de mucho rendimiento, indicando zonas de diversos grados de contaminación. Las medidas protectoras corresponden a cuatro tipos distintos: (a) resguardo, (b) evacuación, (c) transcurso de tiempo y (d) descontaminación.

DISCUSSION

Robert R. Newell, M.D. (San Francisco): Our clinical convictions are that, if the time is increased from a single exposure of one day to over twenty days, then the amount of radiation necessary for the same effect, in the production of severe skin lesions, is almost doubled. It seems to me that this curve is a little steeper than what the essayist has shown.

Mr. Dunning (*replying*): I am not an authority in this field. I can say this, however, that you are describing pretty accurately *one* criterion. The estimates shown here were based on LD 50 for large animals and then extrapolated to man. I think the difference, if there be a difference, lies principally in the criterion used.

Lauriston S. Taylor (Bethesda, Md.): I would like to comment on the problem of the recovery rate in whole-body exposure. This is quite crucial to the whole problem of deciding on exposures under emergency conditions. Up to the present time we have only therapeutic experience to go on, and even where individuals have been exposed to several large fields of radiation we are not, I suspect, provided with the sort of guidance we need when we consider that the entire body is exposed. I believe that as many people as possible should give thought to this particular question in order that we may increase our knowledge regarding recovery rate following whole-body exposure.

Residual Radiation in Civil Defense[1]

EDWIN G. WILLIAMS, M.D.[2]

WIDESPREAD contamination of casualty-producing magnitude, incident to nuclear warfare, constitutes an environmental health hazard of major proportion. Radiological defense is not and should not be a medical program. It is, however, a health program, and the implied responsibilities cannot be ignored. In this connection, the medical profession, especially radiologists and public health physicians, must become more active in administrative and advisory capacities. As is the case with most health programs, preventive and therapeutic measures are involved. It is the responsibility of the medical profession to render such guidance, direction, and assistance as may be necesssary in the non-medical aspects of the program for the most effective protection of the health of the individual, and from a medical standpoint to restore to health the greatest possible number of casualties in the shortest possible time.

Three broad organizational patterns to deal with these problems are being tried. In some states, radiological defense, in its entirety, is a component part of the health structure (in accordance with the Federal recommendation); in others, it is assigned primarily to the health services, with area monitoring delegated to another service such as the police; in a few states it is the responsibility of a separate unit which reports directly to the State Director of Civil Defense. A further experiment in organization is being undertaken to determine the most feasible method of conducting surveys involving large sections of the country.

Radiological defense problems in warfare are produced by initial radiation and residual radiation.

Initial radiation, sometimes called flash or prompt radiation, occurs at the time of the nuclear explosion and ascent of the cloud and is composed of gamma rays and neutrons. It is effective for only a minute or two, but contributes significantly to casualties produced by atomic bombs bursting high in the air. As the yield of the bomb increases, blast and thermal effects tend to outrun those of immediate nuclear radiation. With very high-yield weapons, initial radiation does not present a serious hazard beyond the area where heat and blast are of primary concern.

Residual radiation results from the return to the earth of large amounts of radioactive material during the first few hours after the explosion of a nuclear weapon detonated so that the fireball touches the ground. For purposes of civil defense, it seems reasonable to assume that serious problems of residual radiation would be present over thousands of square miles for each explosion of the very high-yield weapons.

Radiological contamination from such a bomb is distributed in all directions for relatively short distances and in the downwind direction for much greater distances. The area of contamination is largely dependent upon the yield of the weapon. Its location with regard to the point of detonation, and its width and length, are determined by the direction and speed of the winds at various heights and distances. Weather conditions may cause the fallout to be irregular and spotty.

The solution of the radiological problem resolves itself in three categories.

1. *Protective Measures:* (*a*) *Shielding* (shelter or cover). Test data indicate that the radiation level on the first floor of an ordinary frame house would be about one-half, and in the ordinary home basement about one-tenth, that out-of-doors. Es-

[1] Presented at the Forty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 11–16, 1955.

[2] With the Federal Civil Defense Administration, Battle Creek, Mich.

sentially complete protection would be afforded by 3 feet of earth cover or its equivalent. Obviously, these are rough estimates and must be improved upon.

(*b*) *Distance* (by evacuation or by chance).

(*c*) *Time.* If exposure is unavoidable, its duration should be reduced as much as possible.

These precautions may be taken singly or in various combinations, depending on the circumstances.

2. *Remedial Measures:* Decontamination (areas, materials, people) is the principal remedial measure. Also included are the re-establishment of facilities (hospitals, factories, communication centers) in, and the movement of people to, non-contaminated or less contaminated areas.

3. *Therapeutic Measures:* Therapeutic measures are needed in inverse proportion to the effectiveness of protective and remedial measures, and are a part of the Casualty Care Program.

It is evident that radiological defense operations must be generally distributed throughout the country, since almost no community can now consider itself free from potential severe radiological hazard. Radiological reconnaissance and, to an even greater extent, continued radiological monitoring, must be relied upon for information affecting overall decisions of civil defense. In this matter, and particularly in the planning and early operational phases, the meteorologist will play an important role.

The radiological defense organization would be required to develop and supply information to the command and to the medical services regarding amounts of radiation received under various conditions of distance, time, and shielding. At present this is expressed in terms of gamma-ray dose, but an attempt should be made to estimate the neutron and beta contributions. The radiological defense medical advisor would serve as consultant to the command in operational matters and to the medical service in diagnostic and therapeutic matters.

Operationally, early reconnaissance (aerial and ground), follow-up aerial and ground survey and service monitoring, specialists' services, and decontamination, all serve an important function.

Early reconnaissance would be performed by: (1) people using instruments of the survey type at fixed locations, such as fire service engine houses or rendezvous points, or at identifiable but not fixed locations, as police patrol cars or taxicabs, (2) aircraft monitoring, and (3) possibly monitoring by automatic recording or reporting instruments now under experimental study.

Such reconnaissance would permit formulation of initial orders. Follow-up surveys, necessary for checking of the earlier reports and for continued intelligent operation of the civil defense organization, would be maintained throughout the period of dangerous contamination. Most of the methods of early reconnaissance would still be in operation in the follow-up monitoring, with greater reliance placed on service monitors, ground survey teams, and specialists' services.

With regard to specialists' services, certain problems arise after the onset of contamination which require either expert advice or highly specialized study such as radiochemical analyses. For the most part, radiological defense specialists would operate in university or other specialized laboratories, or at headquarters as advisors to the radiological defense chief.

The basic principles of decontamination are fairly well understood and are outlined in the *Technical Manual* (TM-11-6) of the Federal Civil Defense Administration (FCDA). Extensive "operations research" is needed and, to some extent, is being conducted for development or improvement of simple and effective methods of applying decontamination principles. There is a vast difference between the exposure of a few workers in a given field and exposure of whole populations, regardless of the noxious agent. It is important, therefore, in considering the persistence of residual radiation, that we be not misled by maximum permissible dose recommendations

for occupational exposure (whatever their factor of safety). Years after the explosion of an atomic bomb, statistically significant amounts of radioactive contaminants are still available for plant and animal uptake. Diminishing the plant uptake of certain substances can be accomplished, however, by chemical means. This would be advisable when it became necessary to use food crops grown in a contaminated area. In the long run, or in specific instances, it might be better to hasten rather than retard the uptake of these substances and thereby effect a decontamination of the soil.

Specific decontamination teams and equipment are not an established requirement at this time. Rather, it is recommended that we take inventory of present equipment and add to the assignment of personnel familiar with its use the responsibility of decontamination. For example, if the best method for a particular problem is hosing down (and water is available), persons accustomed to the use of equipment such as fire pumps should be expected to perform this duty. Personal decontamination is largely a matter of removing the outer clothing and washing the exposed parts of the body—the sooner the better.

Civil defense instrument requirements for detecting and measuring radiation fall into three distinct classes: (*a*) survey meters for determining contaminated areas and radiation intensities; (*b*) instruments for measuring contamination of people, food, and water; (*c*) dose measuring devices (dosimeters) for civil defense workers. Dosimeters, rate meters, or both for the general public are probably a fourth requirement.

There is no actual experience upon which to base specifications to meet these demands, but it seems to be generally agreed, both in this country and in Europe, that we must be able to detect and measure gamma radiation from slightly above natural background to several hundred roentgens per hour, and that there should be some way of determining intensities of beta radiation. Two dosimeters and a dosimeter charger specifically designed to meet civil defense needs have been produced according to FCDA specifications. The low-range survey meter is of the Geiger-counter type, is beta-gamma discriminating, and has a top range of 50 r/hr. and will meet the major portion of the survey requirements in the period of heavy contamination. The high-range survey meter, also an ionization-chamber instrument, is beta-gamma discriminating, with a top reading of 500 r/hr. It will be used to make high-level beta measurements, and in instances when extremely high intensities are found to exist in areas where civil defense operations are necessary.

The dosimeters are of the quartz-fiber pocket electroscope type, one measuring up to 20 r and the other to 100 r total dose. The requirement for a dosimeter of higher reading to measure flash dose and radiation in individuals receiving more than 100 r from residual radiation is recognized, but no specific instrument has been recommended to meet this requirement. One of the difficulties with regard to the measurement of the initial radiation is the neutron component.

At present, we are not recommending dosimeters for the general public because it is felt that operational disadvantages and uncertainties involved in their use outweigh the possible advantages. Several *Technical Bulletins* on dosimeters have been issued, however, so that in case a state or local director decides to recommend them, he will have information upon which to base a choice. A home-survey meter might enable a family to identify areas of least danger in an indoor contaminated area, or to avoid dangerous areas out-of-doors. Attempts to develop a satisfactory instrument for this purpose are being encouraged.

When the bombs were relatively small, with little or no opportunity for warning, the primary concern in civil defense was shelter. With increased warning capability and greatly advanced weapons the emphasis shifted to evacuation. Now

with wider acknowledgment of the radiological implications, attention is focused upon operational flexibility and versatility to meet a variety of situations where decisions may have to be made between evacuation and shelter or some combination of the two. As with the total program, plans and operations to cope with the radiological problems must be flexible and must change to keep pace with the changing nature and magnitude of the threat.

Federal Civil Defense Administration
Battle Creek, Mich.

SUMARIO

La Radiación Residual en la Defensa Pasiva

Los problemas de la defensa radiológica son creados por: (1) la radiación inicial, llamada a veces radiación de relámpago, que tiene lugar al extallar un arma nuclear y ascender la nube, (2) la radiación residual que proviene del retorno a la tierra de grandes cantidades de substancia radioactiva varias horas después de la detonación y (3) la contaminación. Estos problemas son atendidos con las siguientes medidas protectoras: resguardo, evacuación, descontaminación y procedimientos terapéuticos.

Discute el A. la organización y los procedimientos que intervienen en la defensa radiológica, comprendiendo reconocimiento temprano, exploraciones aéreas y terrestres con servicios de observación, servicios de especialistas e instrumentos para el descubrimiento y la medición de la radiación.

Encarécese que los planes y las operaciones destinadas a resolver los problemas radiológicos sean flexibles, a fin de que marchen en línea con la naturaleza variable y magnitud de los riesgos nucleares.

Fifth Inter-American Congress of Radiology: Opening Address[1]

JAMES T. CASE, M.D., President

Editorial Note: The Inter-American Congresses of Radiology have served to strengthen associations with our Latin-American colleagues and to call attention to their contributions to our specialty. Many of the members of our Society were in attendance at the last Congress, held in Washington, D. C., in 1955. That they may have in more permanent form the opening remarks of the President, Dr. James T. Case, as well as for the benefit of those not privileged to hear Dr. Case in person, we are glad to publish his Presidential Address.

ONCE AGAIN WE are assembled to inaugurate an Inter-American Congress of Radiology, the Fifth. It was most fitting that the Capital of our country be chosen for the celebration of this Congress. In the name of all radiologists of the United States I have the honor to welcome you to this beautiful city, in the midst of the most revered monuments in the history of our Republic.

The term "melting pot" has often been used to describe the character of our citizenry, which is composed of emigrants and descendants of emigrants from almost every country in the world. As a matter of fact, all of the New World republics have, in a lesser or greater degree, received immigration from the Old World and thus become "melting pots" or crucibles for the fusion of diverse nationalities. Actually, regardless of our birthplace or of the race of our ancestors, whether of the South or of the North, *we are all Americans*, citizens of this hemisphere and representatives of the strength of the New World.

The rapid development of radiology as a medical specialty during the first half of this century gave rise to organizations for the study and propagation of knowledge of our chosen work. At first, these groups were local, then national, and eventually international. In the United States three national societies emerged: the American Roentgen Ray Society (1900); the Radiological Society of North America (1915); and the American Radium Society (1916). To these may be added the Section of Radiology established by the American Medical Association in 1924. Many of the radiologists of the United States belong to all four of these organizations; every radiologist belongs to at least one of them. To avoid duplication of effort and to promote the activities of common interest, without diminishing the individual independence of these societies, it became necessary to establish a new organization. Thus in 1923 the American College of Radiology was born. In the College the different societies unite in a collective effort for elevation of the criteria of radiologic practice, for the maintenance and improvement of hospital standards, for attainment of maximum efficiency in radiologic education, for study of the relation between the practice of radiology and public health, and for other purposes indicated by the names of its various committees, as those on cancer, diseases of the chest, radiologic units, standards and protection, drugs and new devices, legislation and public policy, endowments, medical insurance, professional liability insurance, and on international affairs. It was natural, therefore, that the American College of Radiology should act for the radiologists of the United States in sponsoring this Fifth Inter-American Congress of Radiology.

For many years, in this country, the idea of holding a Congress of radiologists of all the Americas was warmly discussed. In June 1929, the preliminary steps toward such a periodic meeting were taken by the American College of Radiology. Various names were suggested. The term *Pan-American* was considered, for it was desired to employ an all-inclusive designation

[1] Delivered in Washington, D. C., April 24, 1955.

but the final selection was the *American* Congress of Radiology. Under the presidency of the late Dr. Henry K. Pancoast, the American Congress of Radiology met in Chicago in 1933, with 26 representatives from Latin America in attendance; 7 were from Argentina, 5 from Mexico, 4 from Cuba, 2 from Salvador, and 1 each from Brazil, Colombia, Ecuador, Guatemala, Panama, Peru, Puerto Rico, and Venezuela. A total of 978 radiologists and physicists registered in the Congress. Among the organizers who are still active in radiology were Drs. Orndoff, Kirklin, Christie, Pfahler, Jenkinson, and Reynolds, as well as your speaker.

In 1937, during the International Congress of Radiology in Chicago, a group of some 40 radiologists from Latin America met several times to consider holding an Inter-American Congress of Radiology. Among the prominent personalities in this activity were Dr. Pedro L. Fariñas and Dr. Manuel Viamonte of Havana and Dr. José Saralegui of Buenos Aires. As a result of these and subsequent conferences, the First Inter-American Congress of Radiology was called in Buenos Aires in 1943, under the presidency of the late Dr. J. Merlo Gómez. With at least half of the radiologists of the United States in the military service of the nation during the Second World War, only one of our radiologists was able to plan to attend, and at the last he was unable to go. At the subsequent Inter-American Congresses of Radiology, in Havana, Santiago, and Mexico City, attendance by radiologists of the United States has been high.

The Colegio Interamericano de Radiología, which developed from the first meeting in Buenos Aires, is the organization under whose auspices the Inter-American Congresses are held. We feel certain that this organization will make itself worthy of the trust and respect of all radiologists and that, without interfering with the individual independence of the national societies, it will become the spokesman for radiology throughout the Americas. The tasks and the successes of this young organization are a credit to its president, Dr. Pedro A. Maissa, and to the national representatives who act as Counselors on its Board. The Inter-American College of Radiology publishes the *Acta Radiológica Interamericana*. The expenses of the main offices of the College, for its correspondence and for the publication of *Acta*, are paid out of the modest dues of its members. We urge that our radiological colleagues of the United States show their interest in the effort to promote continental solidarity by joining the Inter-American College of Radiology.

The close association we have enjoyed with our Canadian colleagues from the early days of radiology has permitted us to appreciate together the friendship of our Latin American colleagues and their admirable contributions to medical radiology. It is proper on this occasion to recall some of these contributions: as those on pneumoperitoneum and perirenal emphysema by Carelli and on bronchography and aortography by Fariñas; the pioneer studies of arteriography and angiocardiography by Castellanos, Pereiras, and their collaborators; the work of Felix Leborgne on tomography of the larynx and of Heuser on hysterosalpingography; the investigations of the radiologic physiology of the bronchial tree and its diagnostic implications by Di Rienzo; the contributions to cholangiography by Saralegui; the original work on angiocardiography by Dorbecker and on mastography by Raul Leborgne. Among the Brazilians who have made outstanding contributions to our specialty, mention may be made of Dodsworth, Duque-Estrada, Saint Pastoux, Cabello Campos, Jany, and notably by Manoel d'Abreu, pioneer in photofluorography. In the field of radiotherapy we recognize Alfonso Esguerra Gómez, the inventor of the Colombia paste; Leonardo Guzmán, founder of the Radium Institute of Santiago; Alfonso Frangella, author of a widely known book on clinical radiotherapy; Oscar Soto, founder of the Institute of Radiotherapy of Lima; González Martinez, the organizer of the

Puerto Rican League Against Cancer; Pantoja of Bogotá; Puey of Montivideo; and innumerable others who have dedicated themselves to the treatment of cancer. Latin American radiology has also been represented by such outstanding educators as Pedro Barcia of Uruguay, who created a veritable pleiad of disciples, including Codas Thompson and Caubarrere. Also notable as teachers were the brothers Lanari of Argentina; Ducci of Chile; in Mexico, Manuel F. Madrazo, the master of international relations in the field of radiology; in Cuba, Pedro L. Fariñas, who left a wide following; in Colombia, Gonzalo Esguerra Gómez, studious academician, also well known for his original contributions to cardioradiology, cholangiography, and leprosy. Time permits mention of only these few; it does not allow a detailed account of the development of radiology in Latin America, a brilliant chapter of which our colleagues can be justly proud.

The discovery of radioactivity by the Curies, which followed closely the work of Roentgen, has been a source of immeasurable benefit to mankind, but it has also carried with it a tremendous burden of responsibility. As Dr. George E. Pfahler has said so well "radium has eased pain, parried death, and given life to numerous cancer sufferers," and yet this same discovery is "the seed from which developed the most potent agent for suffering, death, and mass destruction that the world has ever known." Radioactivity is both "the bane and the blessing of modern man;" it is an "example of the utter impartiality of science in ministering to the best and the worst in us." It is our task as radiologists to direct the infinite possibilities of radioactivity into channels which will serve man in medicine and in all other facets of life. Several hundred useful isotopes can now be produced through the tremendous capacity of existing nuclear reactors. More than fifty countries are utilizing radioisotopes, and in forty-six, the shipments have come from the United States of America. In that country alone there are over four thousand groups using reactor isotopes, and more than ten thousand publications have appeared in the past ten years, all of which represent a valuable contribution to health, agriculture, and industry.

The responsibilities and opportunities resulting from the development of atomic energy are now most apparent. Greater responsibility rests upon us, as radiologists, than upon most citizens, but at the same time atomic energy places in our hands greater opportunities. Our atomic responsibilities should be kept clearly in mind. We should endeavor to keep thoroughly informed on the new developments, which are evolving at a rapid pace. Not only the positive hazard from war use of atomic energy but its expanding peacetime applications have placed additional responsibility on physicians, and on radiologists especially. Radiation hazards will greatly increase as nuclear reactors are employed for commercial power.

It is our earnest hope that this radiologic Congress will prove to be one of the best ever held, and that all those in attendance will find much profit and pleasure in their participation.

2315 Bath St.
Santa Barbara, Calif.

SUMARIO

El Quinto Congreso Inter-Americano de Radiología (Discurso de Apertura)

En el discurso pronunciado en la apertura del Quinto Congreso Inter-Americano de Radiología, se reconstruyen los primeros pasos dados en la organización de los radiólogos de las Américas, comprendiendo el Congreso Americano de Radiología celebrado en Chicago en 1933 y el Primer Congreso Inter-Americano en 1943. Se conmemoran los aportes latino-americanos a la práctica y la enseñanza de la radiología, y se expresa la esperanza de que continúe la actual colaboración.

EDITORIAL

Benign Tumors of the Small Intestine

The roentgen discovery of a benign tumor of the small intestine is an uncommon occurrence in the daily routine of most radiologists. This is due to a variety of reasons. These tumors are, of course, few in number in comparison with others. Their symptomatology is relatively obscure, and frequently it is only at operation that they are found to be the inciting cause of an acute intestinal obstruction. An increasing interest in such tumors is shown by numerous case reports and collected statistical studies.

An unusually valuable collective review has been published recently by River, Silverstein, and Tope (1). These workers collected and analyzed 1,399 benign tumors of the small intestine after having eliminated a variety of tumor-like masses that could not be considered as true benign neoplasms. They state that among 1,000 autopsies benign small-intestinal tumors will be found at least 15 times as often as among a like number of surgical specimens. Yet 72.4 per cent of their collected series were found at operation.

More than two-thirds of all benign small-bowel tumors are of connective-tissue origin. They may be intraluminal or extraluminal, and to some extent this tends to alter the symptomatology and may help determine the question of early or late diagnosis. In the series collected by River *et al.*, more than 43 per cent occurred in the ileum. It is interesting to note that the tumors caused intestinal obstruction in 62.5 per cent of the cases and that in almost 72 per cent of these intussusception was the inciting factor. Intestinal bleeding is the next most common complication. The literature is replete with cases of anemia due to this cause, in which the patient was repeatedly studied, sometimes over many years, before the correct diagnosis was finally established. Bleeding was reported in 30.3 per cent of the series cited. It was severe or exsanguinating in 156 cases, and death resulted in 23. In most cases the bleeding was due to ulceration of mucosa overlying large veins on the surface of the tumor.

The possibility of malignant change in benign tumors is always of interest. Among 59 cases of polyposis with melanin pigmentation (Peutz-Jeghers syndrome) River and his associates found 10 (17 per cent) in which carcinomatous changes occurred. Scattered examples of malignant transformation of leiomyomatous, neurogenic, and vascular tumors were also encountered.

Of 35 benign tumors of the small intestine reported by Rankin and Newell (2), 17 produced no symptoms, being found incidentally during operations for other conditions. Among those cases in which the clinical manifestations initiated studies leading to the final diagnosis, obstruction was present in 50 per cent, and in two-thirds of these intussusception occurred. In 4 cases, gross hemorrhage was present. Rankin and Newell feel that roentgen examination offers the only means of positive preoperative diagnosis of benign tumors of the small intestine. Weber and Kirklin (3), on the other hand, doubt if there are reliable roentgen signs of benignancy. They reported 41 benign tumors, of which 17 were in the duodenum, 10 in the jejunum, 11 in the ileum, and 1 multiple; in 2 cases the location was unspecified. In 36 of this series adequate roentgen studies were done. In 5 cases the lesion was overlooked; in 36 (86 per cent) the lesion was recognized and lo-

cated anatomically, although the precise diagnosis could not always be made.

Dedick and Collins (4), in a report of 10 benign intestinal neoplasms, note that 7 of the patients complained of pain, 7 suffered hemorrhage, and 2 were anemic without evidence of hemorrhage. Seven of the tumors were detected by roentgen examination and one by intubation.

In the series of River *et al.* many of the patients remained asymptomatic or the symptoms were vague and mild. Intraluminal tumors were found to cause earlier symptoms than other types. Pain was the commonest symptom, and this became progressively worse as the obstructive effect of the mass increased. Alternating bouts of diarrhea and constipation, blood in the stools, nausea, and weight loss were not infrequently described. Extraluminal tumors sometimes attained an enormous size before causing symptoms.

From their studies these investigators were led to believe that in the future more of these tumors will be diagnosed by roentgen examination before they cause acute obstruction or dangerous bleeding. In the absence of a filling defect, suspicion of tumor will be based on the following roentgen signs: (1) delay in transit of barium; (2) any degree of ileus; (3) variable appearance of the mucosa and pressure defects from extraluminal tumors; (4) the observation of peculiar "smears" of barium after the meal has passed; (5) irregular pattern of retained barium due to flecks remaining in the interstices of the tumor; (6) demonstration and recognition of the pedicles of polypoid tumors.

This brief summary of successes and failures in the field of benign tumors of the small intestine suggests some valuable lessons to the diagnostic radiologist. Certain authors have pointed out that in almost every case the correct preoperative diagnosis is made by means of x-ray studies. In River's collected series of 1,014 cases, however, in which the tumor was discovered at operation, the correct diagnosis had been made in only 79 instances, but each time by roentgen examination. This is certainly too small a percentage of correct diagnoses. Many cases have been missed by the radiologist either because he was not fully cognizant of the true implication of minor changes from the normal, or because he did not consider the possibility of a benign tumor. In many instances, also, he did not have the full clinical story of the prodromal symptoms and signs upon which to base his judgment.

If we are to improve our percentage of diagnostic accuracy in this field we must keep in mind the possibility of benign tumors in cases of intestinal obstruction, especially those with evidence of intussusception. Hemorrhage from the bowel for which no other cause can be discovered must arouse our suspicion, more particularly in those patients who present familial melanin pigmentation of the lips and oral mucosa. All these manifestations suggest special roentgen examination of the small bowel. Many cases will also be found to have more general clinical findings. Finally, we must secure a more comprehensive clinical history of the patient so that we may act as true consultants.

REFERENCES

1. River, L., Silverstein, J., and Tope, J. W.: Benign Neoplasms of the Small Intestine. A Critical Comprehensive Review with Reports of 20 New Cases. Surg., Gynec. & Obst. Internat. Abstr. Surg. **102**: 1–38, January 1956.

2. Rankin, F. W., and Newell, C. E.: Benign Tumors of the Small Intestine. Report of 24 Cases. Surg., Gynec. & Obst. **57**: 501–507, October 1933.

3. Weber, H. M., and Kirklin, B. R.: Roentgenologic Manifestations of Tumors of the Small Intestine. Am. J. Roentgenol. **47**: 243–253, February 1942.

4. Dedick, A. P., and Collins, L. C.: The Roentgen Diagnosis of Bleeding Lesions of the Small Intestine. Am. J. Roentgenol. **69**: 926–934, June 1953.

ANNOUNCEMENTS AND BOOK REVIEWS

EIGHTH INTERNATIONAL CONGRESS OF RADIOLOGY

Attention is again called to the Eighth International Congress of Radiology to be held in Mexico City, July 22–28, 1956. In a Letter to the Editor (below), Dr. Jorge Ceballos, formerly of Mexico City, now at the University of Texas, offers some suggestions to radiologists planning to attend.

AMERICAN COLLEGE OF RADIOLOGY

The following officers have been elected by the American College of Radiology for the coming year: President, Dr. Wilbur Bailey, Los Angeles, Calif.; Vice-President, Dr. J. P. Rousseau, Winston-Salem, N.C.; Members of the Board of Chancellors, Dr. Earl E. Barth, Chicago, Ill., and Dr. Howard B. Hunt, Omaha, Neb.

TRI-STATE RADIOLOGICAL SOCIETY

At the fourth annual meeting of the Tri-State Radiological Society, serving southern Indiana, northwest Kentucky, and southeastern Illinois, the following officers were elected: Stephen N. Tager, M.D., Evansville, Ind., President; Bart Corsentino, M.D., Vincennes, Ind., Vice-President; Robert E. Beck, M.D., 600 Mary St., Evansville, Ind., Secretary-Treasurer.

CANADIAN ASSOCIATION OF RADIOLOGISTS

At the nineteenth annual meeting of the Canadian Association of Radiologists, recently held in Vancouver, the following officers were elected for the coming year: President, Andrew Turnbull, M.D.; Vice-President, Jean Bouchard, M.D.; Honorary Secretary-Treasurer, Guillaume Gill, M.D.; Associate Honorary Secretary-Treasurer, Norman M. Brown, M.D. The headquarters of the society are Suite 305, 1555 Summerhill Ave., Montreal 25, Quebec.

A REQUEST FOR IDEAS ON AIDS TO BEAM CONTROL IN RADIATION THERAPY

Plans are being made for a Refresher Course entitled "Aids and Gadgets for Beam Control in X-Ray and Radium Therapy" for the December 1956 meeting of the Radiological Society of North America. The object of the course is to present ideas to assure beam and dose control in x-ray and radium therapy. It will deal with devices for obtaining a contour of the patient, dosimetry methods, incident and exit beam control, the shaping of irregular fields with space absorbers, and special aids for use for head and neck tumors. Various aspects of radium-dose control and methods of implanting radium will be introduced.

Ideas and devices are solicited. Any and all such contributions will be identified with the contributor or inventor and proper credit by-lines will be issued. Short discussions will explain the use of the ideas and devices and all of the material will be on exhibit during the question period and after the Refresher Course.

Arrangements should be made through Jesshill Love, M.D., St. Joseph Infirmary, Louisville 8, Ky.

DEUTSCHE RÖNTGENGESELLSCHAFT

The German Roentgen Association has marked the fiftieth anniversary of its founding, May 2, 1905, by the publication of a beautiful brochure containing a reprint of Roentgen's first communication on "the new kind of rays" and accounts of the founding and growth of the Association, the establishment of its library, and the German Roentgen Museum. Portraits of the founders and of the successive presidents of the organization are representative of German radiology and include many whose names are familiar to radiologists the world over. As a tribute to those whose lives have paid the price of progress, a reproduction of the monument to the martyrs of radiology is included and the names inscribed upon it are listed.

The Deutsche Röntgengesellschaft is to be congratulated not only upon its long history but also upon this fitting method of recording it.

Letters to the Editor

TEACHING ROENTGENOLOGY TO SECOND-YEAR MEDICAL STUDENTS

To the Editor of Radiology

DEAR DR. DOUB:

In the Fall of 1953, the authors inaugurated a new approach to the teaching of diagnostic roentgenology to the second-year class at the New York University College of Medicine, which they believe may be of interest to your readers. It consists of demonstrating the roentgen manifestations of abnormalities in an abstract manner without reference to any specific disease. It is really the teaching of gross pathological changes inferentially without specificity.

For example, in a long bone the following changes are demonstrated without mentioning any disease: periosteal thickening, cortical thinning or thickening, medullary expansion or replacement, etc. Similarly, in the chest such changes as pulmonary

consolidation, atelectasis, and pleural fluid are considered. This method of teaching, concurrently with the study of pathological changes, enables the student to translate the gross abnormalities into their roentgen representations and thereby amplifies the significance of each type of abnormality. It thus bridges the gap between the teaching of radiological anatomy in the first year and the teaching of specific diseases in the third and fourth years.

This plan represents a kind of abstract teaching modality which we believe may lay the groundwork for a new respect and appreciation for the roentgen method. Such a course may well prove to be an important discipline in the curriculum of the medical student.

MAXWELL H. POPPEL, M.D.
HAROLD G. JACOBSON, M.D.
New York, N. Y.

FURADANTIN

To the Editor of Radiology

DEAR DR. DOUB:

The very brief discussion of the Nitrofuran compounds in my recent paper "Testicular Cancer: Management of Metastases, with Report of a New Chemotherapeutic Agent," in RADIOLOGY, October 1955, has led to some misinterpretation.

To clarify: the severe symptoms of gastritis, toxic neuritis, and complete testicular atrophy have been seen only with Furacin and Furadroxyl at doses used in the management of metastatic testicular cancer. When Furadantin is used properly for urinary antisepsis, these effects should not occur.

Sincerely yours,

ORLISS WILDERMUTH, M.D.
Columbus, Ohio

EIGHTH INTERNATIONAL CONGRESS OF RADIOLOGY

To the Editor of Radiology

DEAR DR. DOUB:

By this time every radiologist should be aware of the fact that the International Congress of Radiology will be held in Mexico City the last week of July 1956. Those who attended the Inter-American Congress in 1952 are more or less familiar with Mexico. For some this may be the occasion of their first visit. Having just returned from my annual vacation in Mexico, I would like to offer, some suggestions that may help make the trip more enjoyable.

I think we all agree that at a meeting we look forward to some relaxation as well as the scientific program, and for this Mexico is especially adapted.

The first thing to do is to take a little more time than would ordinarily be spent at a scientific meeting. I would recommend driving instead of flying, as this will afford a chance to see more of the country. If one does drive, there is a choice of at least five highways from the Mexican border. Visitors coming from the west coast may reach either of two, one which starts at Nogales, Sonora (across from Nogales, Ariz.) and the other at Ciudad Juarez (across from El Paso, Texas). Easterners may take one of the following: Piedras Negras, Coah (across from Eagle Pass, Texas), Nuevo Laredo, Tamaulipas (across from Laredo, Texas), or Reynosa, Tamaulipas (across from McAllen, Texas). All of these highways are paved, and though they are not as good as those in the United States, it is possible to drive with safety if one doesn't push the accelerator too far.

Two to three days may be taken to drive through Mexico and the time will be well spent, enjoying the scenery, as well as such beautiful cities as Guadalajara, Morelia, San Luis Potosi, Guanajuato (to me, the most colorful city in Mexico), Monterrey, Saltillo, etc.

Another advantage of driving is that one gradually becomes accustomed to the high altitude of the Mexican capital. My blood pressure is in the upper limits of normal and, even though I was born in Mexico City and have been away from it for only five years, I invariably suffered from headaches for one or two days on return visits, until this last year, when I traveled more leisurely.

Also, I have experienced the usual "tourist colitis." (It seems that my "intestinal flora" is more American than Mexican at the present time, and being more aggressive, the Mexican bacteria won the battle against the American, with diarrhea as the result.) To help the American bacteria, I used one tablet of Entero-Vioform after each meal (which, by the way, should be one's first purchase after crossing the border). If that did not help enough I managed to make the Mexican bacteria drunk on red wine. This treatment worked well enough, despite the richness of the Mexican food.

Of course, as soon as the visitor arrives in Mexico City his worries will be over, as he will be in the hands of the Mexican radiologists, whose hospitality is already well known. Meanwhile, it is hoped that these few tips will contribute to enjoyment of the trip to Mexico, in addition to the profit to be derived from the scientific meeting.

Yours very truly,

JORGE CEBALLOS, M.D.
University of Texas, Galveston

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

CANCER OF THE LUNG. PATHOLOGY, DIAGNOSIS, AND TREATMENT. By MILTON B. ROSENBLATT, M.D., Associate Professor of Medicine, New York

Medical College; Visiting Physician and Chief of Chest Clinic, New York City Hospital; Fellow, American College of Chest Physicians, American College of Cardiology, New York Academy of Medicine, American Medical Association; and JAMES R. LISA, M.D., Director, Pathology Service, New York City Department of Hospitals; Director of Laboratories and Pathologist, Doctors Hospital; Fellow, American College of Physicians, American Association of Pathologists and Bacteriologists, New York Academy of Medicine, American Medical Association. A volume of 330 pages, with 129 figures. Published by Oxford University Press, New York, 1956. Price $15.00.

ROENTGEN INTERPRETATION OF FRACTURES AND DISLOCATIONS. By JOSEPH LEVITIN, M.D., Chief, Deparment of Radiology, Mount Zion Hospital, San Francisco, Calif., and BEN COLLOFF, M.D., Associate Chief, Department of Orthopedic Surgery, Mount Zion Hospital, San Francisco, Calif. A volume of 266 pages, with 258 illustrations. Published by Charles C Thomas, Springfield, Ill., 1956. Price $7.75.

PRACTICE IN RADIOTHERAPY. Edited by SIR ERNEST ROCK CARLING, LL.D., F.R.C.S., F.R.C.P., F.F.R., Consulting Surgeon, Westminster Hospital; Chairman, International Commission on Radiological Protection; B. W. WINDEYER, M.B., B.S., D.Sc., F.R.C.S., F.R.A.C.S., F.F.R., Professor of Radiology, University of London; Director, Meyerstein Institute of Radiotherapy, Middlesex Hospital; Consultant in Radiotherapy to the Royal Air Force; and D. W. SMITHERS, M.D., F.R.C.P., F.F.R., Professor of Radiotherapy, University of London; Director, Radiotherapy Department, Royal Cancer Hospital; Consultant in Radiotherapy to the Royal Navy. A volume of 550 pages, with 140 figures and numerous tables. Published by Butterworth & Co., Ltd., London, England, and C. V. Mosby Co., St. Louis, Mo., 1955. Price $20.00.

LUNG FUNCTION IN COALWORKERS' PNEUMOCONIOSIS. By J. C. GILSON and P. HUGH-JONES in collaboration with P. D. OLDHAM and F. MEADE. Medical Research Council Special Report Series No. 290, containing 266 pages, with 96 illustrations and 43 tables. Published by Her Majesty's Stationery Office, London, 1955. Distributed in the United States by the British Information Services, 30 Rockefeller Plaza, New York, N. Y. Price £1 1s. 0d. Net. ($3.78).

ANNUAL REPORT ON THE RESULTS OF TREATMENT IN CARCINOMA OF THE UTERUS. (Previously: Annual Report on the Results of Radiotherapy in Carcinoma of the Uterine Cervix.) Volume 10: Statements of Results Obtained in 1948 and Previous Years (Collated in 1954). Sponsored by American Cancer Society; British Empire Cancer Campaign; Cancerföreningen, Stockholm; Damon Runyon Memorial Fund, New York; Landsforeningen mot Kreft, Oslo; National Cancer Institute of Canada; Oeuvre National Belge de Lutte contre le Cancer. Editorial Committee, DR. J. HEYMAN, (Editor), Stockholm; DR. M. DONALDSON, London; DR. JOE V. MEIGS, Boston; PHIL. DR. C.-O SEGERDAHL, Stockholm. A paper-bound volume of 346 pages. Published by P. A. Norstedt & Söner, Stockholm, 1955.

PROGRESS IN BIOPHYSICS AND BIOPHYSICAL CHEMISTRY. Volume 6. Edited by J. A. V. BUTLER, Professor of Physical Chemistry, University of London, Institute of Cancer Research, Royal Cancer Hospital, London. A volume of 274 pages, with 108 illustrations. Published by Pergamon Press, London and New York, 1956. Price £3.0.0 ($9.50).

A.M.A. SCIENTIFIC EXHIBITS 1955. Sponsored by Council on Scientific Assembly, American Medical Association. A volume of 784 pages, with numerous illustrations. Published by Grune & Stratton, New York, N. Y., 1955. Price $20.00.

NINETEENTH SEMIANNUAL REPORT OF THE ATOMIC ENERGY COMMISSION, January 1956. 200 pages. United States Government Printing Office, Washington, D. C.

RÖNTGENOLOGISCHE DIFFERENTIALDIAGNOSE DER KNOCHENERKRANKUNGEN. By PROF. DR. HANS HELLNER, O. Professor für Chirurgie, Direktor der Chir., Univ.-Klinik, Göttingen, and DR. HANNO POPPE, Facharzt für Röntgenologie, Leiter der Röntgen-Abteilung der Chir., Univ.-Klinik, Göttingen. An atlas of 904 pages, with 842 figures. Published by Georg Thieme Verlag, Stuttgart, 1955. Distributed in the United States and Canada by the Intercontinental Medical Book Corp., New York, N. Y. Price Dm 270.—($64.30).

RÖNTGENAUFNAHMETECHNIK IN DER HALS-NASEN-OHRENHEILKUNDE. By DR. MED. BURKHARD SCHLOSSHAUER, Hamburg. A monograph of 48 pages, with 72 illustrations. Published by Georg Thieme Verlag, Stuttgart, 1956. Distributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y. Price Dm 12.—($2.85).

TRABAJOS DE ONCOLOGIA Y RADIOTERAPIA. Años 1953–1954. Facultad de Medicina. Publicationes del Instituto de Radiología y Ciencias Fisicas, bajo la Dirección del PROF. ALFONSO C.

FRANGELLA, Director Interino del Instituto; Prof. Honorario F. de Medicina Universidad Nal. de Colombia. A volume of 526 pages, Imprenta "Rosgal," Montevideo, 1955.

Book Reviews

RECENT ADVANCES IN RADIOLOGY: By THOMAS LODGE, M.B., Ch.B. (Sheff.), F.F.R., D.M.R., Consultant Radiologist, United Sheffield Hospitals and Sheffield Regional Hospital Board; Clinical Teacher in Radiodiagnosis, University of Sheffield; Hon. Editor, *Journal of the Faculty of Radiologists*. A volume of 358 pages, with 182 illustrations. Published by Little, Brown & Co., Boston. Third Ed., 1955. Price $10.50.

The first and second editions of *Recent Advances in Radiology* appeared under the editorship of Dr. Peter Kerley, in 1931 and 1936. Dr. Thomas Lodge, who edits the present edition, states that it is written "from the standpoint of the radiologist working in the general hospital, in an endeavour to relate recent work to his particular requirements and problems as opposed to those of the specialist radiologist." The term "recent" may be open to some question, since no references of later date than 1953 are included. The author, however, forestalls criticism on this score by requesting a wide interpretation of the word as he has used it. "The book does not pretend to be a summary of all modern work." On the other hand, for the sake of consolidating gains and giving continuity and perspective to work undertaken in recent years, reference is frequently made to studies not strictly contemporary but having an essential place in the development of radiological thought.

The text comprises ten chapters dealing with the various systems of the body. The descriptive material is clear and easily read, although necessarily brief in some areas. The illustrations are well selected and show good detail, but unfortunately are reproduced as positives rather than the familiar negatives.

A bibliography follows each chapter and an adequate index is included. While by its very nature this work is not a complete radiologic text, it will nevertheless be valuable for the material on current conceptions of this speciality.

ATLAS OF BRONCHIAL LESIONS IN PULMONARY TUBERCULOSIS. A CLINICAL AND MORBID-ANATOMICAL STUDY. By C. DIJKSTRA, M.D., Medical Superintendent of the Sanatorium "De Klokkenberg," Breda, The Netherlands, A volume of 128 pages, with 131 illustrations. Published by Charles C Thomas, Springfield, Ill., 1955. Price $11.00.

With the increasing use of bronchoscopy and bronchography, much light has been thrown upon the bronchial lesions of tuberculosis. To the clinical observations made through these technics, the author adds essential data based upon histopathologic examinations of resected lungs. He presents his material in the form of an atlas of 30 cases selected to demonstrate all stages of pulmonary tuberculosis, together with long-standing complications.

Each case is briefly presented with the essential clinical, roentgenologic, and pathologic findings and appropriate illustrations. The latter are in general well selected and informative. Many bronchograms are included.

Those who are interested in the basic pathology of the various stages of pulmonary tuberculosis will find this volume of special interest. The fact that all the cases have had careful clinical evaluation makes this pathological study of fresh material unusually significant.

ADVANCES IN CANCER RESEARCH. Vol. III. Edited by JESSE P. GREENSTEIN, National Cancer Institute, National Institutes of Health, U. S. Public Health Service, Bethesda, Md., and ALEXANDER HADDOW, Chester Beatty Research Institute, Royal Cancer Hospital, London, England. A volume of 370 pages with numerous tables and graphs. Published by Academic Press, Inc., New York, N. Y., 1955. Price $8.50.

This is the third of a current series of volumes designed to follow the course of cancer research. Volumes I and II have been reviewed in earlier issues of RADIOLOGY (**61**: 951, 1953; **63**: 431, 1954). The present one deals with the metabolism of neoplastic tissues and carcinogenesis in general and lung and thyroid tumors in particular. The book will, for the most part, be of greater interest to workers in biological research than to radiologists. The first chapter, however, "Etiology of Lung Cancer," will have a general appeal for all who are concerned with the cancer problem. It deals with the increased incidence of pulmonary cancer, principally in men, and the significance of cigarette smoking in production of the squamous, oat-cell, and undifferentiated varieties. Other types occurring equally in both sexes, and of stable incidence, are mentioned, and such possible causative factors as pollution of air and atmospheric radioactivity are evaluated.

The chapter on "Pulmonary Tumors in Experimental Animals," including methods of increasing their occurrence will be of special interest to research workers. The induction of thyroid tumors and information obtained by their study are also considered, along with some observations on thyroid cancer in man and the possibility of an increased incidence following I^{131} therapy for thyrotoxicosis. The extensive bibliographies are valuable.

Contributors to the volume are Richard Doll of the London School of Hygiene and Tropical Medicine; Harold P. Morris and Michael B. Shimkin of

the National Cancer Institute, Bethesda, Md.; A. and B. Pullman of the Radium Institute, Paris; P. Rondoni of the Cancer Institute, Milan, Italy; and Sidney Weinhaus of the Lankenau Hospital Research Institute, Philadelphia.

RADIOACTIVITY AND RADIOACTIVE SUBSTANCES. By SIR JAMES CHADWICK, D.Sc., LL.D., F.R.S. With Foreward by Lord Rutherford, O.M., D.Sc., LL.D., F.R.S. Revised and Supplemented by Prof. J. ROTBLAT, M.A., Ph.D., D.Sc., F. Inst. P. A monograph of 120 pages with 41 illustrations and 12 tables. Published by Pitman Publishing Corporation, New York, N. Y., Fourth Ed., 1953. Price $3.00.

This little book written by Sir James Chadwick in 1921 has been revised and supplemented to bring it up to date. In a surprisingly small space the main facts about radioactivity are presented in a clear, concise manner. The discussion of the properties and emission of the radiations from radioactive substances involves explanation of atomic theory, and the description of equipment for measuring them brings in their action in ionizing gases. Artificially created radioactive isotopes are only briefly mentioned, the book dealing mainly with naturally radioactive substances and their transformations. Mathematics is kept to a minimum. Graphs, charts, and tables add to the clarity and usefulness of the book. It should be of value to beginners in the field of radioactivity and to those wanting a brief review.

GRUNDLAGEN UND PRAXIS DER BEWEGUNGSBESTRAHLUNG. VORTRÄGE DES 2. BONNER RÖNTGENOLOGISCHEN WOCHENENDKURSUS. By H. LANGENDORFF, W. K. LELBACH, R. JANKER, and K. ROSSMANN. Fortbildungskurse auf dem Gebiete der Röntgenologie und der Strahlenheilkunde. Herausgegeben von Professor Dr. R. Janker, Bonn. Band II. A volume of 212 pages, with 148 illustrations and 26 tables. Published by Verlag W. Girardet, Wuppertal-Elberfeld, 1955. Price DM 40.—

This seminar on "moving irradiation" contains seven chapters. The first two serve as an introduction to the main theme of the work. In the first, on the "Radiobiological Basis of Modern Radiation Therapy," Prof. H. Langendorff discusses the factors which influence the susceptibility of living tissues to radiation: their water and oxygen content, their temperature and metabolic activity, and the action of endocrine and/or autonomic determinants. In the second chapter, on "Histological Changes in Irradiated Carcinomata," Dr. Werner K. Lelbach attempts to answer the oft debated question whether the most effective damage inflicted by exposing a neoplasm (carcinoma) to ionizing radiation is (*a*) necrosis of the (epithelial) tumor cells, (*b*) hyaline degeneration of the connective stroma, or (*c*) interruption of the blood supply. Presumably all three (and perhaps additional) mechanisms occur, one or the other predominating under given circumstances.

The chapter on "Methods of Moving Irradiation" is by Prof. R. Janker, who begins with a brief history of pioneering German achievements in this field (such as Werner's "static convergent irradiation" of 1907) and goes on to describe the modern technics. These he divides into single-plane motion and multiplane motion. This chapter contains also an "inventory of definitions" and the requirements and plans for an ideal model, capable of furnishing any of the types of motion described.

Under the heading "Dosimetry of Moving Irradiation" Dr. Karl Rossmann describes small thimble chambers which can be introduced into various body cavities for direct dose measurement. He strongly recommends permanent monitoring, since in the course of convergent therapy, a combination of mistakes (wider diaphragm and shorter cone than prescribed) might result in a dose of 1,000 r to the skin instead of 64 r. Detailed diagrams and accurate descriptions of the various physical factors are presented, together with isodose tables and extensive data. Essentially practical in scope is the chapter on the "Setting-Up of Ports and Dosage Planning" by the same author; it includes treatment outlines for specific cases and many helpful particulars, such as dosage corrections calculated for bone structures interposed in the irradiated volume or for protruding soft-tissue parts.

The two concluding chapters are by Janker. He proposes "normalizing" patients for moving irradiation by using a supportive plastic arch around a "bulging" pelvis, with bolus material for the filling of "empty" spaces. For convergent irradiation of the head, he molds a paraffin disk to fit the irregularities of the face, which assures a smooth course for the isodoses. Finally, indications and practical experiences are recounted. Observations on 432 patients (between July 1953 and March 1955) have convinced the author that moving irradiation has a place in therapy, especially when combined with other methods, such as contact irradiation, radium, and isotopes.

The bibliography, with over 220 references, covers most of the European literature and even includes a fair number of "foreign" authors.

Despite a few omissions (wedge filters, the use of transverse tomography to outline the body part for calculation of portals, changes required for adaptation to super- and megavoltage, etc.) this book will undoubtedly be of help to those who wish to enter this field. Whether its complicated technology is worthwhile remains a matter of personal philosophy. In ultimate analysis, the "test of the pudding" lies in the end-results (prolongation of life and degree of palliation), but so far adequate comparative follow-up studies are not available, and only these can provide a satisfactory answer to this question.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Robert E. Fricke, M.D., Mayo Clinic, Rochester, Minn.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

ASSOCIATION OF UNIVERSITY RADIOLOGISTS. *Secretary-Treasurer*, Robert J. Bloor, M.D., 260 Crittenden Blvd., Rochester 20, N. Y. Next Annual Meeting at the University of Rochester, May 19–20, 1956.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 E. 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James J. Riordan, M.D., 550 W. Thomas Rd., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Joe A. Norton, M.D., 843 Donaghey Bldg., Little Rock. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Austin R. Wilson, M.D., 540 N. Central Ave., Glendale 3.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Richard A. Kredel, M.D., 65 N. Madison Ave., Pasadena 1. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, H. B. Steward, Jr., M.D., 2920 Capitol Ave., Sacramento. Meets last Monday of each month, September to May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA. *Secretary-Treasurer*, James B. Irwin, M.D., 1831 Fourth Ave., San Diego.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, Howard L. Steinbach, M.D., University of California Medical Center, San Francisco 22. Meets quarterly, at Grison's Steak House.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Thomas N. Foster, M.D., 630 E. Santa Clara St., San Jose. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, James T. English, M.D., 2000 Van Ness Ave., San Francisco 9. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Dorr H. Burns, M.D., 1776 Vine St., Denver. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, John Burbank, M.D., Meriden Hospital, Meriden. Meets bimonthly, second Wednesday.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, John A. Long, M.D., 1801 K St., N.W., Washington 6. Meets third Wednesday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Donald H. Gahagen, M.D., 320 Sweet Bldg., Fort Lauderdale. Meets in April and in October.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, André S. Capi, M.D., 300 N. 20th Ave., Hollywood, Fla. Meets monthly, third Wednesday, 8:00 P.M.

NORTH FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Marvin Harlan Johnston, M.D., Five Points Medical Center, Jacksonville 4. Meets quarterly, March, June, September, and December.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Charles M. Silverstein, M.D., 3254 Peachtree Rd., N. E. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Herbert M. Olnick, M.D., 417 Persons Bldg., Macon, Ga. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta. Meets first Thursday of each month.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary-Treasurer*, George W. Henry, M.D., 1133 Punchbowl, Honolulu. Meets third Monday of each month.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary-Treasurer*, R. Burns Lewis, M.D., 670 N. Michigan Ave., Chicago 11. Meets at the Sheraton Hotel, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, Chester A. Stayton, Jr., M.D., 313 Hume-Mansur Bldg., Indianapolis 4. Meets twice a year, first Sunday in May and during fall meeting of State Medical Association.

TRI-STATE RADIOLOGICAL SOCIETY (Southern Indiana, Northwestern Kentucky, Southeastern Illinois). *Secretary-Treasurer*, Robert E. Beck, M.D., 600 Mary St., Evansville, Ind. Meets last Wednesday, October, January, March, and May, 8:00 P.M., at the Elks' Club, Evansville, Ind.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, G. S. Ripley, Jr., M.D., W. Iron Ave., Salina. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, David Shapiro, M.D., Jewish Hospital, 217 E. Chestnut St., Louisville 6. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer*, W. S. Neal, M.D., 602 Pere Marquette Bldg., New Orleans.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Walter A. Russell, M.D., Augusta General Hospital, Augusta. Meets in June, October, December, and April.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, Nathan B. Hyman, M.D., 1805 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Paul W. Roman, M.D., 1810 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, E. F. Lang, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

UPPER PENINSULA RADIOLOGICAL SOCIETY. *Secretary*, Arthur Gonty, M.D., Menominee. Meets quarterly.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, O. J. Baggenstoss, M.D., 1953 Medical Arts Bldg., Minneapolis 2. Meets in Spring and Fall and at annual meeting of State Medical Association.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Packer, M.D., 621 High St., Jackson. Meets monthly, on third Tuesday, at 6:30 P.M., at the Hotel Edwards, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary-Treasurer*, D. R. Germann, M.D., University of Kansas Medical Center, Kansas City 3, Kans. Meets last Friday of each month.

GREATER ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Sam J. Merenda, M.D., 45 Berry Road Park, Glendale, Mo. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, John Stewart, M.D., Billings Clinic, Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Thomas J. Crowe, M.D., 53 Center St., Northampton, Mass. Meets second Friday of October and April.

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Raymond A. Dillon, M.D., 24 Wedgemere Ave., Winchester, Mass. Meets monthly on third Friday, October through May, at the Hotel Commander, Cambridge, Mass.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnson, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, George G. Green, M.D., 601 Grand Ave., Asbury Park. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

BROOKLYN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Theodore Kamholtz, M.D., 152 Clinton St. Meets first Thursday, October through May.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clayton G. Weig, M.D., 135 Linwood Ave., Buffalo. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Solomon Maranov, M.D., 1450 51st St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Frances M. Behrendt, 19 Clinton Rd., Garden City, N. Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Maxwell H. Poppel, M.D., 550 First Ave., New York 16.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert R. Wadlund, M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

RADIOLOGICAL SOCIETY OF NEW YORK STATE. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, T. Paul Guest, M.D., 277 Alexander St., Rochester. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maynard G. Priestman, M.D., New Rochelle Hospital, New Rochelle, N. Y. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, William H. Sprunt, M.D., North Carolina Memorial Hospital, Chapel Hill, N. C. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Marianne Wallis, M.D., Minot. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Hannan, M.D., 10515 Carnegie Ave., Cleveland 6.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur R. Cohen, M.D., 41 S. Grant Ave., Columbus. Meets second Thursday, October, November, January, March, and May, 6:30 P.M., Fort Hayes Hotel, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur S. Tucker, M.D., Cleveland Clinic. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Richard J. Neubauer, M.D., 831 Carew Tower, Cincinnati 2. Meets first Monday, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, N. L. Bline, M.D., 210 Jackson Tower, Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club, Portland.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Richard Raines, M.D., 214 Medical-Dental Bldg., Portland 5, Ore. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Walter P. Bitner, M.D., 234 State St., Harrisburg. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Herbert M. Stauffer, M.D., Temple University Hospital, Philadelphia 40. Meets first Thursday

of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Norman Tannehill, M.D., 601 Jenkins Bldg., Pittsburgh 22. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at the Hotel Roosevelt.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Freed, M.D., 4200 E. Ninth Ave., Denver 7, Colo. Next meeting Aug. 16–18, 1956, at Denver.

South Carolina

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Samuel W. Lippincott, M.D., 103 Rutledge Ave., Charleston. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

The Southwest

SOUTHWESTERN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Gordon L. Black, M.D., 1501 Arizona Bldg., El Paso.

Tennessee

MEMPHIS ROENTGEN SOCIETY. *Secretary*, Benjamin E. Greenberg, M.D., 294 Annella St., Memphis 11. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, George K. Henshall, M.D., 311 Medical Arts Bldg., Chattanooga 3. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH RADIOLOGICAL CLUB, *Secretary*, Albert H. Keene, M.D., 3707 Gaston Ave., Suite 116, Dallas. Meets monthly, third Monday, 6:30 P.M., at the Greater Fort Worth International Airport.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Leslie L. Lemak, 616 Medical Arts Bldg., Houston 2. Meets fourth Monday at the Doctors' Club.

SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY. *Secretary*, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Bldg., San Antonio 5, Texas. Meets at Brook Army Medical Center, second Wednesday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., 1308 Manteo St., Norfolk 7.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Eva L. Gilbertson, M.D., 1317 Marion St., Seattle 4. Meets fourth Monday, September through May, at 610 Pine St., Seattle.

West Virginia

WEST VIRGINIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. Paul Elkin, M.D., 515–519, Medical Arts Bldg., Charleston. Meets concurrently with annual meeting of State Medical Society, and at other times as arranged by Program Committee.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Jerome L. Marks, M.D., 161 W. Wisconsin Ave., Milwaukee 1. Meets monthly on fourth Monday at the University Club.

SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. W. Moir, M.D., Sheboygan Memorial Hospital, Sheboygan.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Rafael A. Blanes, M.D., Box 9724 Santurce, Puerto Rico.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, D. L. McRae, M.D., *Assoc. Hon. Secretary-Treasurer*, Guillaume Gill, M.D., *Central Office*, 1555 Summerhill Ave., Montreal 25, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTRO-RADIOLOGIE MÉDICALES. *General Secretary*, Ls Ivan Vallée, M.D., Hôpital Saint-Luc, 1058 rue St-Denis, Montreal 18. Meets third Saturday of each month.

L'ASSOCIATION DES RADIOLOGISTS DE LA PROVINCE DE QUEBEC. ASSOCIATION OF RADIOLOGISTS OF THE PROVINCE OF QUEBEC. *Secretary*, Isadore Sedlezky, M.D., 3755 Cote St. Catherine Road. Meets four times a year.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPÍA DE CUBA. *Secretary*, Dr. Rafael Gómez Zaldívar. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA, A. C. *Headquarters*, Calle del Oro, Num. 15, Mexico 7, D. F. *Secretary General*, Dr. Guillermo Santín. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Cardiovascular System

The Diaphragm

The Digestive System

The Spleen

The Musculoskeletal System

Gynecology and Obstetrics

The Genitourinary System

The Adrenals

Technic

RADIOTHERAPY

RADIOISOTOPES

RADIATION EFFECTS; EXPERIMENTAL STUDIES; PROTECTION

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

The Radiological Criteria and Familial Occurrence of Primary Basilar Impression. J. W. D. Bull, W. L. B. Nixon, and R. T. C. Pratt. Brain **78:** 229–247, June 1955.

The radiological diagnosis of basilar impression is established by measuring the relationship of the upper parts of the cervical spine to the skull. The authors compare three different measurements and discuss the familial distribution of primary basilar impression and the light that this throws on the validity of the three criteria.

The first criterion is that of Chamberlain (Yale J. Biol. & Med. **11:** 487, 1939), who stated that in normal subjects "all parts of the atlas and axis lie caudad of the base line" drawn from the dorsal margin of the hard palate to the dorsal lip of the foramen magnum. Saunders (Radiology **41:** 589, 1943), in an investigation of normal individuals, found that in 1 person in 3 the tip of the odontoid lay above Chamberlain's line. McGregor (Brit. J. Radiol. **21:** 171, 1948. Abst. in Radiology **52:** 445, 1949) introduced a modification of Chamberlain's line, namely, "the line drawn from the upper surface of the posterior edge of the hard palate to the most caudal point of the occipital curve in the true lateral x-ray." Bull (Proc. Roy. Soc. Med. **40:** 85, 1946) pointed out that in cases of basilar impression secondary to bone softening it is the weight-bearing parts of the occipital bone, namely, the anterolateral parts adjacent to the foramen magnum, which rise. Since the condylar portions of the atlas rise *pari passu* with the occipital condyles, it was suggested that the angle between the plane of the hard palate and the plane of the atlas would measure the degree of basilar impression. The plane of the atlas is obtained by drawing a line from the middle of the anterior arch of that vertebra to the middle of the posterior arch, as seen in a lateral view. This angle has not been found to vary with the degree of flexion or extension of the neck.

Lateral views of the radiologically normal skulls of 120 patients seen in the National Hospital, London, were chosen for study, each decade between the ages of ten and sixty-nine years being represented by 10 males and 10 females. From each roentgenogram determinations were made of the values of Chamberlain's measurement, McGregor's measurement (that is, the perpendicular distances between the odontoid tip and the respective base lines), and the angle between the plane of the hard palate and the plane of the atlas (angle β).

Application of the provisional criterion of abnormality derived from the three measurements for the 120 subjects led to a diagnosis of primary basilar impression in 20. In 18 the findings were abnormal according to the angle β, 12 were abnormal according to the Chamberlain criterion, and 12 according to the McGregor criterion; 9 were abnormal according to all three criteria and 6 abnormal according to the angle β alone. In 10 patients the abnormality was an incidental finding, in 7 patients a clinical diagnosis of syringomyelia had been made, and in 3 the neurological symptoms and signs could be explained by a local lesion at the level of the foramen magnum.

Thirty-nine relatives of the 20 radiologically abnormal patients were studied. Twenty-nine were found to be normal and 10 abnormal by at least one criterion. Six were abnormal by all three criteria, and the other 4 by the angle β alone; all 10 were symptom-free.

For statistical purposes, the values of the angle β for the whole material (120 normal subjects + 20 abnormal patients + 39 relatives) were combined into a single frequency distribution; this was bimodal, with a high peak at an average value of about 0° for normals and a lower peak at about +16°, representing an average abnormal value. This single distribution was analyzed by a maximum likelihood method into two "normally" distributed components. This method does not assume that a particular value of the angle belongs to one or other of the two (overlapping) component distributions but provides estimates of their mean values and standard deviations and of the proportion of mixture in the total material. On the basis of the results, the authors conclude that primary basilar impression is best detected by observation of the angle between the plane of the hard palate and the plane of the atlas.

Although too few patients were studied to enable a firm conclusion to be drawn, it is believed that primary basilar impression is a genetically determined skeletal abnormality and that the mode of inheritance is mendelian dominance with an occasional failure of manifestation of the abnormal gene.

Six roentgenograms; 1 chart; 12 tables.

Unilateral Exophthalmos Due to Orbitofrontal Cholesterol Granuloma. John W. Hanbery and Mark Rayport. Am. J. Surg. **89:** 1144–1162, June 1955.

Four cases of unilateral exophthalmos due to a solitary orbitofrontal destructive lesion are presented, together with a summary of 5 previously reported cases. All the patients were males, and the age range was from twenty-eight to fifty-seven years. In only 2 cases was there an associated history of trauma. The most common symptoms, which were present from a few weeks to several years, were prominence of one eye and diplopia. These were associated with forward, inferior, and medial displacement of the eye. In 6 patients there was a visible or palpable prominence of the lateral portion of the involved supraorbital ridge.

All of the cases showed x-ray evidence of an osteolytic lesion confined to the lateral portion of the supraorbital ridge, with involvement of the adjacent frontal squama, the orbital roof, and the zygomatic process of the frontal bone. The frontal and ethmoid sinuses were not involved. No other cranial or skeletal osteolytic lesions were recorded.

In each instance local excision was followed by prompt recovery, without evidence of recurrence. In one case irradiation (6,000 r) several months prior to exenteration produced temporary improvement. Operative findings were similar in all cases: a cavity with soft, yellowish-brown, gritty material and compression of the orbital fascia. There was no invasion through the orbital fascia or the frontal dura.

Microscopically, the findings were those of granuloma containing numerous cholesterol crystal clefts associated with multinucleated foreign-body giant cells, foam or xanthoma cells, blood pigment, and dense col-

lagenous tissue, particularly at the periphery of the lesion. No true capsule was noted.

The authors could not explain the etiology of these lesions, although it was postulated that they might be a chronic, benign form of Schüller-Christian granuloma occurring in adults as a solitary destructive lesion. Another possibility suggested is that they may have originated from eosinophilic granulomas which had undergone fatty degeneration associated with fibrous connective tissue growth.

Four roentgenograms; 19 photographs and photomicrographs; 1 table. EMIL H. SCHNAP, M.D.
Buffalo, N. Y.

THE CHEST

Routine Preoperative Chest Radiography. Analysis of 1,000 Cases. R. E. Loder. Lancet **1**: 1150, June 4, 1955.

Since the purchase of a 5 × 4-inch radiographic camera at the Peterborough Memorial Hospital, Northants, England, it has become routine to take a chest roentgenogram immediately upon a patient's admission to the hospital for surgery. The film is inspected by the radiologist and abnormal findings are communicated at once by telephone to the anesthetist. Of 1,000 chest roentgenograms taken between July and December 1954, 116 were reported as abnormal. In 29 cases operation was postponed. The radiological observations are grouped as follows:

Congenital abnormalities: 9 cases. The only case of importance in this group was a large pulmonary conus in a child.

Thickened pleura and diaphragmatic adhesions: 14 cases.

Emphysema: 7 cases. One of these showed a localized area of emphysematous bullae.

Collapse of, and/or infection in, lung: 19 cases, 8 of which were in children. Six cases were considered to be of a minor nature. Of the 13 major infections or collapses, 3 were in cases of carcinoma requiring immediate treatment, which was instituted with such precautions as could be applied. In 3 cases early in the series, the report was received too late and operation was performed without preliminary treatment; in all 3, severe postoperative complications developed.

Tuberculosis: In 35 patients, healed calcified primary complexes, calcified foci with no evidence of recent disease, or calcified hilar nodes were reported. Seven adults were found to have pulmonary tuberculosis; in only 1 was the disease already known to be present.

Cardiovascular disease: In 19 cases, cardiac enlargement or hypertensive heart configuration was present.

Bone metastases: A dense opacity in the 4th rib was reported in a patient admitted for prostatectomy. A carcinoma of the prostate was diagnosed.

In the author's opinion the discovery of 6 cases of adult pulmonary tuberculosis alone justifies the taking of these films.

Physiological Bronchography. Charles A. Priviteri. Am. J. Roentgenol. **73**: 958–965, June 1955.

The author describes a technic for bronchography by which the need for multiple positions is eliminated. His method is based on the hypothesis that deep inspiration might distribute the opaque medium throughout the bronchial tree in a satisfactory manner.

The only premedication consists in administration of Nembutal gr. 3/4 (or 1 1/2 gr. in a large patient). Transnasally, a 16F urethral cathether is inserted into the trachea, 2 to 3 inches above the carina, and the patient is placed on the roentgenoscopy table in a supine position and rotated 45° toward the side to be filled. Under roentgenoscopic guidance 15 c.c. of Lipiodol is instilled rapidly. The catheter is withdrawn and the patient is returned to the supine position and instructed to take a deep breath. He is then rolled into a prone position and asked to take another deep inspiration. A final roentgenoscopic survey is made and films are taken.

The author has studied 170 cases and reports incomplete filling in only 12 observed early in the development of the technic. Results in the last 125 examinations were consistently satisfactory.

Twenty roentgenograms; 2 tables.
J. P. CHAMPION, M.D.
Grand Rapids, Mich.

The Choice of a Contrast Medium for Bronchography. G. Bianchi. Ann. di radiol. diag. **27**: 377–388, 1955. (In Italian)

The author discusses the advantages and disadvantages of iodized oils, of water-soluble opaque media, of iodized oil with sulfanilamide, and of a suspension of Diodone crystals (Dionosil), for bronchography. He believes that iodized oil with sulfanilamide and a suspension of Diodone crystals offer good opacity, adequate tolerance, and freedom from persisting shadows following the procedure.

Two roentgenograms. CESARE GIANTURCO, M.D.
Urbana, Ill.

Observations on Aqueous and Oily Media in Lungs of Experimental Animals. L. C. Smith and James A. Harrill. Ann. Otol., Rhin. & Laryng. **64**: 588–598, June 1955.

Gross and microscopic findings in the lungs of rabbits given 1 c.c. of Umbradil Viscous B, Iodochlorol, or normal saline intratracheally are described. Grossly the lungs of animals receiving Umbradil Viscous B or Iodochlorol showed patchy areas firmer than normal and discolored reddish-brown in twenty-four hours. These findings persisted for ten days but became progressively less marked. With saline no gross changes were noted after forty-eight hours.

Microscopically, twenty-four hours after injection with Umbradil Viscous B patchy areas of bronchopneumonia were found. After four days the reaction became less acute. Special stains revealed carboxymethyl cellulose in specimens up to ten days. With Iodochlorol the twenty-four-hour reaction was less acute than with Umbradil Viscous B; the reaction became more pronounced through the sixth day and there were areas of focal necrosis in the tenth day specimen. Globules of lipoid material were demonstrated in the tissue. Those animals injected with saline showed an initial acute inflammatory reaction which subsided by the sixth day.

Eighteen photomicrographs. G. W. REIMER, M.D.
Palo Alto, Calif.

Reducing Observer Error in a 70-mm. Chest-Radiography Service for General Practitioners. Peter Stradling and R. N. Johnston. Lancet **1**: 1247–1250, June 18, 1955.

In an effort to find a simple way of reducing observer error in a 70-mm. chest-radiography service, single

readings of one and two views in 1,000 cases were compared with dual readings of the same films.

Two observers independently reading a single postero-anterior roentgenogram achieved greater accuracy (98 per cent) than either alone (89 per cent and 91 per cent). The addition of an anteroposterior lordotic view increased the abnormality yield of either reader working alone (to 91 per cent and 94 per cent) but was less effective than the single view read by two observers. Adding the lordotic view was of greatest value in avoiding unnecessary recalls.

In the authors' opinion, dual reading is essential in radiographic surveys, and a routine second view saves anxiety, time, and expense,

Two figures; 2 tables.

Pulmonary Agenesis. Roentgenographic and Postmortem Findings in One Patient; Hemodynamic and Angiocardiographic Findings in Another. Harriette Clark, Roland B. Scott, and John B. Johnson. Pediatrics **15**: 761–767, June 1955.

Two cases of agenesis of the lung, both with anomalies of the urinary tract, are reported. In one the diagnosis was made at necropsy at the age of five weeks. Associated anomalies in this patient included defect of the interatrial septum, anomalous drainage of the pulmonary vein into the right atrium, and congenital bilateral ureterovesical obstruction with dilatation of the ureters and kidney pelves.

In the second patient, the diagnosis of agenesis of the left lung was made at the age of three years and confirmed by follow-up studies twelve years later. On fluoroscopy there was a narrowing of the costal interspaces on the affected side. The diaphragm was in normal position on the right and freely mobile but was not demonstrable on the left. The structures in the mediastinum were markedly shifted to the left. When inspiratory and expiratory films were superimposed, the difference was negligible. The conventional frontal roentgenogram confirmed the fluoroscopic findings and showed a small area of aeration in the upper third of the left thorax and in the vicinity of the sternum. This aeration of the upper one-third of the left thorax had been progressive over the twelve-year period. Bronchography failed to reveal evidence of bifurcation of the trachea. Angiocardiographic studies showed that the heart was displaced to the left and so rotated that the right ventricle faced and was in close apposition to the left axillary chest wall. The main stem pulmonary artery was enlarged, taking an arched sweeping course from the left lateral chest across into the right without bifurcation, so that no left pulmonary artery branch was seen. The arteries supplying the lung tissue in the left chest arose as terminal branches of this single pulmonary artery, similar to the arteries supplying the lung tissue in the right chest. Pyelography disclosed pelvic location of fused kidneys with short ureters bilaterally. In this patient, the lung anomaly did not result in any dysfunction of the heart or pulmonary circulation. There had been some decrease in ventilatory function but not sufficiently severe to produce respiratory symptoms.

Eight roentgenograms; 2 tables.

Congenital Cysts of the Lung. James G. Donald and John W. Donald. Ann. Surg. **141**: 944–949, June 1955.

Three cases of congenital cysts of the lung are reported. Unlike acquired cysts, congenital cysts are said to have an endothelial or epithelial lining.

Case I: A 40-year-old white woman with a six-week history of low-grade fever and cough was found on roentgen examination to have a well defined thin-walled cavity in the lower right chest. At surgery an infected cyst was identified and right lower lobectomy was performed.

Case II: A 6-year-old white boy was seen with a history of acute symptoms referable to the left lower chest and upper abdomen, of a weeks duration. Thoracentesis yielded a thick yellow-green fluid containing pus cells, and roentgenography following this procedure showed a cystic lesion of the left lower lobe. The lobe was resected after removal of dense adhesions to adjacent structures and was found to contain a multilobulated, trabeculated cyst filled with purulent fluid.

Case III: A 21-year-old Negro woman had a history and physical findings strongly suggestive of tuberculosis with cavitation, but sputum studies were negative for tubercle bacilli. Roentgen examination revealed a spherical mass containing multiple cavities in the left upper lobe. The lobe was resected and pathologic examination showed a secondarily infected bronchial cyst.

All three of these patients did well following operation and are considered cured. The authors make a plea for more prompt surgical attack on congenital lung cysts. They feel that lobectomy is frequently to be preferred to enucleation of the cyst. An anomalous artery, though not common in association with an intralobar bronchogenic cyst, must be looked for at operation.

Six roentgenograms; 3 photographs.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

The Middle Lobe Syndrome. A Review of the Anatomic and Clinical Features. Donald B. Effler and John R. Ervin. Am. Rev. Tuberc. **71**: 775–784, June 1955.

The middle lobe syndrome is characterized by recurrent pneumonitis due to obstruction of the bronchus to this lobe. The bronchus arises approximately 2 cm. below the upper lobe orifice and is 2 cm. or more in length. Because of its length and pliability, it is readily compressed when a group of three or more peribronchial nodes which encircle it become enlarged. The compression results in atelectasis followed by secondary pneumonitis. The lobe may then re-expand or remain obstructed. In the latter event, destruction of the lobe ensues. If re-expansion occurs, there may or may not be bronchiectasis due to the obstruction and infection.

The writers believe that the initial obstruction is probably brought on by an acute inflammatory process which produces hilar lymphadenitis. This results in compression of the bronchial lumen, and associated edema and swelling may lead to complete obstruction. Until obstruction is produced, the only radiographic sign is hilar enlargement, which may or may not be recognized. With development of obstructive pneumonitis, the roentgenographic findings become those of lobar consolidation. If the obstruction persists, the lobe will begin to contract and the decrease in volume will distinguish it from the appearance in pneumococcal pneumonia. When the obstruction is transient, complete recovery may ensue. Usually obstruction con-

tinues until permanent damage results. This may take the form of bronchiectasis or a permanent bronchostenosis which leads to progressive destruction of the lobe.

In a group of 32 patients in whom surgical resection was done, the middle lobe syndrome was found to appear in a wide age range—eleven to fifty-eight years. The most common symptom was chronic productive cough. Most of the patients complained of intermittent fever, fatigue, and exacerbation of symptoms during upper respiratory infections. Duration of symptoms in this group ranged from three months to twelve years.

The roentgenographic appearance in the chronic middle lobe syndrome is fairly characteristic. There is a hazy triangular density in the right central lung field below the hilus which is noted to lie anteriorly on the lateral view and is often shown to be demarcated by the secondary and primary fissures. Bronchography may show complete or incomplete obstruction, or it may show no obstruction with middle lobe bronchiectasis. Bronchoscopy can be used to visualize the bronchial orifice. Diagnosis can often be made by routine roentgenography. Surgical extirpation of the lobe is indicated in the majority of cases.

Ten roentgenograms; 5 diagrams.

JOHN H. JUHL, M.D.
University of Wisconsin

Lipoid Pneumonia. Aubrey O. Hampton, Charles E. Bickham, Jr., and Theodore Winship. Am. J. Roentgenol. **73**: 938–949, June 1955.

Lipoid pneumonia is caused by the aspiration of animal, mineral, or vegetable oils administered either orally or nasally, usually for medicinal purposes. Some of the oil may enter the bronchial tree and produce pathologic changes. Individual susceptibility is assumed to play a role, as not all persons who take oils contract the disease. The authors report a series of 35 cases, 10 of which came to autopsy. Twenty-two patients had ingested the oil voluntarily; in 8 the condition was attributed to nose drops, in 2 to milk and cod liver oil, and in 1 to petroleum jelly. In 2 cases no history of oil ingestion was obtainable.

Cough, dyspnea, and chest pain were the most frequent complaints. One adult had hemoptysis, and both children in the series had recurrent attacks of pneumonia. Nineteen of the patients were males. The age range was from three months to eighty-six years. Only 2 were Negroes. None of the patients was debilitated, and prior to their present illness, all were well. The most common physical signs were dullness to percussion, harsh breath sounds, and bronchial or bronchovesicular breathing.

The roentgen findings were of two main types, diffuse and nodular, represented by 24 and 11 cases, respectively. In the diffuse type, fine linear, spunglass shadows occurred, sometimes sharply defined but more commonly fading out into the lung fields. Intermingled with the densities were rarefied areas representing aerated lung. The general impression produced was that of fibrosis. The nodular type was characterized by homogeneous soft-tissue shadows, varying in size from several centimeters in diameter to large areas. In some cases the margins were sharply defined; in others they were irregular, with fine projections into the adjacent tissue. Sometimes the areas decreased in size and became denser, and the patient showed clinical improvement. In 5 of the cases there was occlusion of the major bronchus to a lobe, usually the right middle lobe. In 1 infant collapse of the right upper lobe followed aspiration of milk. The middle lobe was completely collapsed in 4 cases.

Bronchography was done on 12 patients. The most common finding was obstruction of the terminal bronchi in the involved area, from various causes. Minimal pleural effusion was observed twice.

In this series of 35 cases, involvement was bilateral in 21 and unilateral in 14. The lower lobes were most commonly affected. In the 14 unilateral cases, the disease was on the right in 12 and on the left in 2. Though the changes have been considered irreversible once the condition is well established, discontinuance of administration of oil resulted in clinical and roentgen improvement in a few instances.

Lipoid pneumonia must be differentiated from lymphatic spread of carcinoma, pulmonary edema, tuberculosis, atypical pneumonia, lobar pneumonia, infarction, Boeck's sarcoidosis, and bronchiectasis.

Pathologically, the lesions which appeared nodular roentgenographically resembled carcinoma. The lungs diffusely involved were firm and subcrepitant, and their surfaces were mottled yellowish-gray and black. In the late stage of the disease, replacement of pulmonary tissue by fibrosis was noted. Most of the alveoli had disappeared or were represented by round spaces lined by fibrous tissue. These contained conglomerate masses of desquamated alveolar lining cells, oil, and debris. Vascularity was minimal. Special staining showed loss of elastic tissue in all but the large vessels. The only pathologic finding in the living patient was the presence of intracellular oil in the sputum.

No therapeutic measure for removal of oil from the lungs is known.

Twenty-two roentgenograms; 2 photomicrographs; 1 table.

H. C. JONES, M.D.
Grand Rapids, Mich.

Planigraphy (Body Section Radiography) in Detecting Tuberculous Pulmonary Cavitation. Edward A. Favis. Dis. of Chest **27**: 668–673, June 1955.

This report is based on 271 planigrams taken on 172 patients over a period of five years for determining or confirming the presence of cavitation. All patients had pulmonary tuberculosis, and cavities found were considered tuberculous.

Of the 271 planigrams, 10.7 per cent revealed cavitation of which there was no suggestion on the conventional films. In an additional 8.8 per cent cavitation which was only suspected on routine examination was conclusively shown. In 3.3 per cent the planigrams failed to reveal a cavity which was reported as being present on conventional roentgenography, while in 18.8. per cent planigraphy failed to confirm the presence of suspected cavities.

Planigraphy should by no means be considered the "last word" in the detection of cavities. The knowledge gained from this procedure should be used with other findings that may be present to determine the activity of a particular case. The identification of a cavity in portions of lungs collapsed by thoracoplasty is quite difficult. The authors have established the following rule: "Before any radiolucency can be called a cavity, its walls can be made up of no such structures or part of structures as blood vessels, ribs, transverse processes, or bodies of vertebrae, fibrotic strands, or thickened pleura, walls of a bronchus, or any of the spic-

ules of regenerated ribs so often seen in patients who have had thoracoplasties." Honeycombed areas are usually not labeled cavities. These were practically all found in the upper lobes and were referred to as "bronchiectatic cavities." Bronchographic study has confirmed that these more often represent bronchiectasis than tuberculosis.

The authors conclude that planigraphy is an aid in establishing the presence of pulmonary cavitation and also in differentiating between small tuberculous cavities and "bronchiectatic cavitation."

Three tables. JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Tuberculous Disease in Resected Specimens. P. L. Logan. Am. Rev. Tuberc. **71**: 830–840, June 1955.

Forty-three resected lung specimens from tuberculous patients were examined and the macroscopic observations were correlated with findings on postero-anterior and lateral films and on postero-anterior tomograms. Correlation was good in 25 cases, fair in 11, and poor in 7. Poor correlation occurred more often in lower lobe disease, in females, and in patients with basal pleural disease. It appeared that caseous foci must be more than 0.5 cm. in diameter or must be calcified in order to be visualized. A number of specimens which were excised because of a single large focus contained many satellite foci of a similar type which had not been visible roentgenographically.

Microscopic examination of apparently normal lung tissue showed that the disease was much more extensive and active than had been realized. Some involvement was found in nearly all of the specimens examined. The activity appeared to be related to the duration of preoperative chemotherapy, since no active disease was found in macroscopically normal specimens when antituberculous drugs had been given for four months or more.

The conclusion is that chemotherapy is indicated for several months and that the roentgenographic findings should be stable for six months before resectional surgery is attempted in tuberculosis.

Two roentgenograms; 3 photomicrographs; 2 photographs; 4 tables. JOHN H. JUHL, M.D.
University of Wisconsin

Ante-Mortem and Post-Mortem Angiography of the Pulmonary Arterial Tree in Advanced Tuberculosis. Raul Cicero and Alejandro Celis. Am. Rev. Tuberc. **71**: 810–821, June 1955.

The pulmonary arterial circulation in 29 patients with far advanced tuberculosis was studied by means of angiography. For comparison, 4 apparently normal persons and 1 patient with bronchiectasis were examined in a similar manner. Twenty of the tuberculosis patients died, the thoracic contents were removed *en bloc*, extrapleurally, and the pulmonary arteries were injected with a barium suspension following inflation of the lungs with air. Roentgenograms were taken, and the specimens were examined histopathologically.

A number of alterations in the vessels were noted roentgenographically. The peripheral arterial circulation was diminished, especially in recent lesions. Lobar and segmental arteries of relatively large diameter were absent in a number of cases. In extensive destructive disease, there was a complete change in the normal architecture of the arterial tree, with thin branches surrounding the cavity walls. After collapse therapy the arterial tree was found to be in a mesh arrangement.

Histopathologic changes were those of obliterating endarteritis, especially in the arterioles and capillaries in which angiographic changes had been found. Both the bronchial and pulmonary arteries were involved, and focal lesions were present in some vessels which were in close proximity to a tuberculous lesion.

A number of clear-cut differences between the antemortem and postmortem findings were observed and were felt to be due to physiologic mechanisms which tended to reduce the blood supply during life. This resulted in a tendency for angiograms of the living to show less vascularity than the necropsy specimens. In some instances, the vascularity as demonstrated in the living tended to parallel pulmonary function more closely than the anatomic findings postmortem.

Thirteen roentgenograms; 4 photomicrographs.
JOHN H. JUHL, M.D.
University of Wisconsin

Roentgen Observations in Infectious Mononucleosis. A. Bogsch. Fortsch. a. d. Geb. d. Röntgenstrahlen **82**: 785–789, June 1955. (In German)

Among 60 patients with infectious mononucleosis, 35 were found to have peripheral lymphadenopathy, while 7 had involvement of mediastinal and hilar nodes. The hilar lymph-node enlargement was unilateral in some cases and bilateral in others. It was minimal in every instance. Six patients had parenchymal pulmonary infiltration. In 3 the infiltrations were in the infraclavicular region, resembling tuberculosis; in the remaining 3, large, patchy infiltrates in the lower lobes were suggestive of bronchopneumonia.

Several cases showed splenomegaly, which in some instances was pronounced enough to displace the stomach. Characteristically, the enlargement of the spleen is in the transverse direction. In one case there was a "pelotte-like" filling defect in the antrum of the stomach, which was believed to be produced by enlarged lymph nodes.

Two roentgenograms.
ALEXANDER R. MARGULIS, M.D.
University of Minnesota

Respiratory Disorders Among Welders. Robert Charr. Am. Rev. Tuberc. **71**: 877–884, June 1955.

Pulmonary siderosis in welders is ordinarily not considered to be a disabling disease. In 2 of the cases reported here, histopathologic study of pulmonary tissue showed definite fibrosis associated with deposits of iron, but the extent was minimal and there were no respiratory symptoms referable to the siderosis. Pulmonary function studies, done on 4 patients, gave findings consistent with mild emphysema. One patient had been a welder for twenty years and complained of cough, expectoration, dyspnea on exertion, and chest pain. Roentgenograms revealed scattered nodulations throughout both lung fields, similar to the findings in early nodular silicosis.

In a study of roentgenograms of approximately 250 welders, the author found pulmonary changes in 5 per cent, consisting in exaggerated pulmonary markings and, in some cases, scattered nodular shadows. These changes were not related to the clinical findings, and the general rule was that the symptoms were proportionate to the age of the welder irrespective of the roentgen findings.

Further histopathologic studies are necessary to determine whether deposits of iron oxide in the lungs of welders invariably cause fibrosis.

Two roentgenograms; 3 photomicrographs.

JOHN H. JUHL, M.D.
University of Wisconsin

Diabetes Insipidus and Pulmonary Fibrosis. William I. Freud. Arch. Int. Med. **95**: 823–827, June 1955.

Two cases of diabetes insipidus associated with pulmonary fibrosis, without known cause, are reported, with a review of the literature. Both the author's patients, young males, presented a classic picture of diabetes insipidus with x-ray findings of diffuse nodular infiltration widely disseminated through both lung fields, interpreted as pulmonary fibrosis. A lung biopsy on one of these patients was reported as showing chronic pneumonitis with pulmonary fibrosis.

Diabetes insipidus and pulmonary disease have been found secondary to sarcoidosis, eosinophilic granuloma, and Schüller-Christian disease. No etiologic explanation in the author's cases was found. The pathologic features in these and cases previously recorded are compared.

One roentgenogram; 1 photomicrograph.

THEODORE E. KEATS, M.D.
University of California, S. F.

Granuloma of Lung Due to Radiographic Contrast Medium. Franklin Fite. Arch. Path. **59**: 673–676, June 1955.

During fluoroscopic examination of the upper gastrointestinal tract of an 81-year-old woman with carcinoma of the larynx, it was observed that, while most of the barium meal (Gastropaque) passed readily into the stomach, some of it was aspirated into the lung fields. A roentgenogram showed nodular radiopacities in both lower lobes, most abundant on the left. The patient's condition gradually deteriorated, and she died fifteen days later. Autopsy study of the lung, including chemical analysis of lung tissue, disclosed a barium granuloma.

Granulomas similar in all respects to that found in the case presented were produced in rabbits by endotracheal injection of a watery suspension of barium. Comparable peritoneal reactions to barium sulfate, usually due to perforation of an ulcer during examination of the gastrointestinal tract, have also been recorded.

One roentgenogram; 7 photomicrographs.

Anatomic Interpretation of Cross-Sectional Stratigraphy of the Mediastinum. N. Macarini and G. Buzzi. Ann. di radiol. diag. **27**: 439–453, 1955. (In Italian)

The authors present a study of 11 anatomical cross sections of the thorax and compare with them 11 cross-sectional radiographs obtained by axial transverse stratigraphy. Studies such as these are essential for the correct interpretation of axial stratigrams of the thorax.

Twelve roentgenograms; 11 schematic drawings.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Modified Breathing Esophagram for Demonstration of Mediastinal Shift. P. Lörinc and L. Baumann. Fortschr. a. d. Geb. d. Röntgenstrahlen **82**: 800–803, June 1955. (In German)

The method of Schoenheinz (Fortschr. a. d. Geb. d. Röntgenstrahlen **80**: 453, 1954) for demonstration of mediastinal shift uses the barium-filled esophagus as a landmark and films taken in deep inspiration and expiration. The movement of the esophagus is evaluated in respect to a metallic marker attached to the skin over the sternum.

According to the authors, this method can lead to erroneous conclusions if there is rotation of the patient; in costal breathing the sternal marker changes position and is not in relation to the same segment of esophagus in expiration and inspiration. They therefore attach another metallic marker, shaped like the letter H, to the skin of the back opposite the sternal marker (which is shaped like an arrow). If the two markers are not superimposed on the film, rotation has occurred.

Fifty normal subjects were studied by this method, and in 10 a minor deviation to the left was observed in inspiration. In none was there deviation to the right. The shift was never greater than 2 cm. It is attributed to displacement of the stomach by the diaphragm in inspiration. This possible normal deviation must be taken into account in the interpretation of inspiratory esophagrams.

Seven roentgenograms.

ALEXANDER R. MARGULIS, M.D.
University of Minnesota

Posterior Mediastinal Goitre. A Report of Eleven Cases. Kenneth N. Morris. Australian & New Zealand J. Surg. **24**: 241–250, May 1955.

Posterior mediastinal extension of an enlarged thyroid represents an unusual form of intrathoracic goiter. The essential difference between it and the more common anterior (retrosternal) extension is that in the former the goiter descends behind the carotid sheath and superior vena cava; in the latter the extension is anterior to these vessels (Sweet, R. H.: Surg., Gynec. & Obst. **89**: 57, 1949. Abst. in Radiology **54**: 903, 1950). The author records his experience in 11 patients.

An important feature of the radiologic investigation that differentiates a mediastinal goiter from a neurogenic tumor is that the former moves with swallowing. This observation was made in all cases where screening was carried out. Other masses arising from the trachea or esophagus cannot be excluded by this procedure and probably the only way a positive diagnosis can be made is by measuring the radioiodine uptake over the mass.

For treatment, the author recommends a cervical incision if the mediastinal extension is small. For the large tumors a combined cervical and sternum splitting approach is favored.

Fourteen roentgenograms.

D. D. ROSENFELD, M.D.
Oakland, Calif.

Angiographic Studies in Intrathoracic Goiter. A. Rossi. Ann. di radiol. diag. **28**: 259–260, 1955. (In Italian)

The author differentiates between retrosternal goiter and another type, which he calls latero-retrovisceral. The following statements apply to both varieties.

Compression of the large veins of the lower portion of the neck is demonstrated in all cases, even when clinical signs of stasis have not yet appeared. The innominate veins are pushed downward and laterally and two sharp bends are noted: (1) where the subclavian vein enters the innominate and (2) immediately below the innominate-caval junction. The lateral boundary

of the retrosternal mass is formed by the dilated innominate veins engorged with blood. This lateral opacity, very evident according to the author, is *less* dense than the bulk of the parenchymatous growth.

It is recommended that angiography be performed with *direct* injection of the opaque medium, without catheter; the procedure should be carried out bilaterally at the same time. In this way a complete evaluation of the functional anatomy of the large neck veins is obtained.

The benign nature of the retrosternal mass and its thyroid origin are demonstrated by the extrinsic compression of the large vessels, and by the fact that the elasticity of the venous walls is preserved. The mediastinal shadow of the goiter is movable during deglutition and often shows calcium deposits. If the mass is fixed, it will move upward *rapidly* when the patient coughs.

These studies are useful in differentiating an intrathoracic goiter from other upper mediastinal masses and give important information as to operability and the best surgical approach. R. G. OLIVETTI, M.D.
Newington, Conn.

Traumatic Hemomediastinum. Eugene G. Laforet. J. Thoracic Surg. **29**: 597–603, June 1955.

There are few available reports on the occurrence of mediastinal hematoma despite current emphasis on mediastinal disease and increased number of chest injuries. The incidence of hemomediastinum following thoracic injury is probably much higher than is indicated by the literature.

Significant mediastinal hemorrhage of non-traumatic origin may follow rupture of a thoracic aneurysm, uremia, typhoid fever, hemorrhage into a parathyroid adenoma, etc. Traumatic hemomediastinum is usually the result of venous bleeding except in penetrating wounds, where arterial hemorrhage may predominate. Chest injuries, such as compression or severe concussion, sustained in automobile accidents will give rise to mediastinal bleeding.

On x-ray study the mediastinum is widened and may show straight vertical borders. Roentgen differentiation from mediastinitis or other mediastinal lesions may be difficult.

An illustrative case report is included. The patient, twenty years old, fell asleep at the wheel of his car and struck a tree. After regaining consciousness he was found to have dyspnea, distended neck veins, and a right Horner's syndrome. Films of the chest revealed a dense soft-tissue mass involving the superior mediastinum, mostly on the right, with displacement of the trachea to the left.

No surgical intervention was indicated, since the clinical condition improved rapidly. Follow-up films thirty hours after the injury showed striking regression of the hematoma, and approximately two weeks later the roentgen appearance of the chest was normal. Dyspnea and the Horner's syndrome disappeared.

Four roentgenograms. JOHN F. RIESSER, M.D.
Springfield, Ohio

THE CARDIOVASCULAR SYSTEM

Experimental Transbronchial Cardio-Angiography. Mansur Taufic and Joseph J. Asta. J. Thoracic Surg. **29**: 676–678, June 1955.

Intravenous angiocardiography has been of little aid in detecting left-to-right intracardiac shunts and in visualization of the left side of the heart and the thoracic aorta. Attempts to inject contrast material under pressure into the pulmonary artery have apparently not improved the results. Direct injection into the left ventricle does not visualize the left atrium accurately. Other technics are similarly of limited applicability.

The procedure described here was carried out in a series of 2 normal dogs and 4 dogs with experimentally produced interventricular septal defects and proved left-to-right shunts.

After anesthetization with pentobarbital sodium a bronchoscope was inserted into the trachea until the carina was visualized. A 15-gauge needle fitted to a saline-filled aspirating tube was passed through the bronchoscope and inserted into the left atrium through the wall of the left main stem bronchus 1 cm. from the carina. Diodrast (70 per cent), 1 c.c. per kilo, was injected rapidly under manual pressure. Four films were taken per second.

In the normal dogs there was good detail of the left atrium, left ventricle, arch of the aorta, and brachiocephalic arteries. The dogs with septal defect in every case showed shunting of the contrast medium from left to right. Electrocardiographic tracings revealed no significant changes either during or after injection of the Diodrast. With increasing progress in intracardiac surgery, more exact methods of diagnosis are necessary and this procedure may have potential value in the human patient.

Two roentgenograms. JOHN F. RIESSER, M.D.
Springfield, Ohio

Studies of Circulation Time During the Valsalva Test in Normal Subjects and in Patients with Congestive Heart Failure. Paul Stucki, J. D. Hatcher, Walter E. Judson, and Robert W. Wilkins. Circulation **11**: 900–908, June 1955.

In the normal subject the Valsalva test (expiratory effort against a closed glottis after full inspiration) causes a brief rise in blood pressure initially, followed by a fall in systolic, diastolic, and pulse pressures. Patients in congestive failure show a rise in systolic and diastolic pressure with no change in pulse pressure. Some patients in moderate failure have an intermediate response.

The study reported in the present paper was undertaken to determine the effect of the Valsalva maneuver upon circulation time in the presence and absence of congestive failure. In normal subjects the circulation time was prolonged by approximately the duration of the expiratory effort; in patients in failure circulation time was not retarded or only partially so. Radioscopic studies in normal and congestive subjects by catheter injection of opaque solutions showed that in the normals the venous return was blocked at the entrance to the chest, but that in those in failure no such impediment existed.

It is concluded that the difference in pressure responses to the Valsalva test are due to the difference in cardiac output: In failure it is maintained and thus there is no fall in pressure, while in normals the block in venous return causes a prompt drop in output and hence in pressure.

Five roentgenograms; 4 graphs; 3 tables.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Angiocardiographic Study of a Case of Double Aortic Arch Without Symptoms. Mohamed Nazih Zuhdi and Harold A. Lyons. Am. J. Med. **18:** 1022–1025, June 1955.

A case of complete double aortic arch is presented. The patient had no symptoms or signs referable to the anomaly. A plain frontal roentgenogram of the chest revealed a right upper mediastinal mass which was pulsating during fluoroscopy. Angiocardiography demonstrated a normal heart and pulmonary vessels. The aorta was visualized arising from the left ventricle in the normal fashion and proceeding upward to the right, filling two arches. The descending aorta turned to the right, then swung back to the left and disappeared below the diaphragm. The vascular ring was composed of two well developed aortic arches, apparently of equal size.

Five roentgenograms; 3 drawings.

HOWARD L. STEINBACH, M.D.
University of California, S. F.

Coarctation of the Aorta in Unusual Sites. Bengt Hulting and Aado Vendsalu. Acta radiol. **43:** 453–458, June 1955.

Coarctation of the aorta is occasionally seen in the lower thoracic or abdominal region. It is suggested by notchings limited to the lower ribs, and by a normal left mediastinal contour in the presence of clinical signs of coarctation. It has been reported as being caused by a neurofibroma embracing the aorta, by the organizing of a thrombus, by inflammation around the aorta, and by congenital malformation. The length of the coarctation has varied from 1 to 10 cm., and its location from the lower thoracic region to just below the renal arteries.

Angiocardiographic diagnosis of coarctation in this unusual location is not always possible, and retrograde carotid injection or aortography may be required. When the condition is suspected and such studies are negative, the examinations should be repeated to expose the entire aorta.

The authors report a case with the constriction at the level of the diaphragm.

Two roentgenograms.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

An Unusual Case of Coarctation of the Aorta. Leif Efskind and Axel Sanderud. J. Thoracic Surg. **29:** 665–669, June 1955.

There are two usual types of coarctation of the aorta: (1) the adult type with a short stenosis below the point of origin of the left subclavian artery, and below or at the level of the ligamentum arteriosum; (2) the infantile type located above the ligamentum and, as a rule, so long that surgical reconstruction is difficult.

In the case reported here a double stenosis was found, with a small intermediate chamber which was the point of origin of the left subclavian artery. The patient was a 6-year-old boy who had shown normal development to the age of five. He then became unable to take part in play with other children, was sullen, and tired easily, and his feet were cold. There was vigorous pulsation of the right radial artery but a feeble pulse on the left. A similar difference was observed in pulsations in the neck. Roentgen study demonstrated a slightly enlarged heart and increased width of the vascular trunk at the base on the left, as with a dilated subclavian artery. An impression in the esophagus at the level of the fifth and sixth ribs was thought to be due to poststenotic dilatation of the aorta. There were costal impressions on the right but not the left.

At operation, two vessels were found to arise from the top of the strongly pulsating aortic arch. The first was as large as the aorta and was apparently the innominate, with ample blood supply to the right arm and neck. Below this arose a lesser blood vessel, assumed to be a trunk common to the carotid and subclavian arteries. Above and below the departure of the latter vessel, the aorta was greatly constricted.

Resection of the aorta was performed, combined with anastomosis between the innominate artery and the common trunk of arteries to the left side. Because of deficient collateral circulation, it was not considered justifiable to ligate the subclavian artery.

The day after operation a distinct pulse was felt in both lower extremities, which were warmer than previously. The blood pressure was nearly the same in upper and lower extremities. The postoperative course was uneventful.

Three photographs with diagrams.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Aortic Stenosis Associated with Aneurysmal Dilatation of the Ascending Aorta. Lucio Di Guglielmo and Mariano Guttadauro. Acta radiol. **43:** 437–444, June 1955.

The authors report a case of aortic valvular stenosis with post-stenotic dilatation of the aorta, in which diagnosis was possible on the basis of clinical and radiologic signs. A review of the usual features of this abnormality is also presented.

Frequently the disorder occurs in association with arachnodactylia, and such cases appear to be based upon a mesenchymal dysplasia. In others, hydromechanical forces incident to passage of blood through a congenitally narrow valve cause structural fatigue and distention of the elastic aortic wall.

Diagnosis of a stenosis is possible in the presence of valvular calcifications. Angiocardiographic demonstration of the aneurysm frequently shows dilatation of the vessels arising from the arch and always reveals a sharp return of the aortic caliber to normal beyond the left subclavian artery.

Four roentgenograms; 2 drawings.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Oliguria Following Diagnostic Translumbar Aortography. Report of a Case. Benjamin A. Barnes, Robert S. Shaw, Alexander Leaf, and Robert R. Linton. New England J. Med. **252:** 1113–1116, June 30, 1955.

Translumbar aortography has been looked upon by some as a fairly innocuous procedure in selected patients, and one group of investigators has reported a series of 1,000 cases without a death or significant morbidity (Smith, Rush, and Evans: J.A.M.A. **148:** 255, 1952. Abst. in Radiology **60:** 627, 1953). However, many complications have been described. Among these are acute iodism, extravasation of the contrast medium, hematoma formation, direct injection of secondary arterial branches with subsequent injury to the organ supplied, and prolonged oliguria as in the case recorded here. The diagnostic information to be gained, therefore, should warrant the attendant risks.

The authors' patient was a 57-year-old salesman

with symptoms derived from effort ischemia of the heart and legs. Four months earlier an aortogram had been obtained at another hospital, with no apparent ill effect, revealing a block in the abdominal aorta. To determine the present status of the aortic block, translumbar aortography was undertaken. After an initial extravasation of 20 c.c. of 70 per cent iodopyracet (Diodrast), the study was completed with 50 c.c. There was transient nausea and retching but no unusual immediate reaction. The aortogram showed good filling of the branches proximal to a block of the aorta at the level of the third lumbar interspace; the iliac arteries filled from rich anastomoses.

Four days after the examination, bilateral submaxillary adenitis was observed; one day later oliguria accompanied by weight gain, puffiness of the face, and azotemia occurred. On the eighth day a pericardial rub was noted, followed in two days by left cardiac failure. For one week there was painful swelling of the left elbow and knee, and for another week significant personality changes. Some thirty-four days after the injection, the patient was able to leave the hospital.

The oliguria lasted nine days. The authors attribute this major complication either to the high concentration of Diodrast reaching the kidneys as a result of the aortic block or to an allergic reaction following exposure to an iodinated compound during previous aortography.

One roentgenogram; 1 graph. SAUL SCHEFF, M.D.
Boston, Mass.

Anomalous Drainage of Pulmonary Veins. Clinical, Physiologic and Angiocardiographic Features. Gonzalo Sepulveda, Daniel S. Lukas, and Israel Steinberg. Am. J. Med. **18**: 883–899, June 1955.

Three cases of partial and 3 of total anomalous pulmonary venous drainage into the right atrium or its tributaries are reported and the main clinical, physiologic, and angiocardiographic features are discussed.

Among the group with partial anomalous pulmonary venous drainage, 1 case was uncomplicated and asymptomatic. The 2 patients with symptoms had associated defects—pulmonic stenosis in 1 and rheumatic mitral stenosis in the other. In the latter patient, the demonstration of an elevated pulmonary "capillary" pressure in the normally draining lung as compared to a normal venous pressure in the lung with anomalous drainage led to a definite diagnosis of mitral stenosis and successful surgical correction of the valvular lesion.

All 3 patients with total anomalous drainage of the pulmonary veins had symptoms and 2 were cyanotic. Similarity of blood-oxygen content in the right ventricle and the pulmonary and systemic arteries is a diagnostic feature of the anomaly.

Symptoms are dependent on the amount of pulmonary tissue that is drained anomalously. In venous drainage from one lung the patient is asymptomatic; when the anomalous drainage is complete, symptoms are invariably present. These include varying degrees of dyspnea, fatigue, cyanosis, clubbing, and polycythemia. There is usually a systolic murmur of variable intensity in the 2nd and 3rd intercostal spaces, sometimes accompanied by thrill.

Roentgenography is the most important simple examination which by itself may reveal the diagnosis of transposition of the pulmonary veins. An anomalous right pulmonary vein draining into the inferior vena cava usually appears on the roentgenogram as a broad branching channel which curves in crescentic fashion near the right cardiac border and descends toward the right cardiohepatic region. Usually the right atrial silhouette is prominent. Increased pulmonary vascular markings due to an associated interatrial septal defect may obscure the anomalous pulmonary vein.

Pulmonary veins inserting into the left innominate vein have a characteristic x-ray appearance. Whether the anomalous drainage is partial or complete, there is a wide channel (a persistent left superior vena cava) at the left hilus and superior mediastinum. As a result of the large volume of blood which it transmits, the right superior vena cava dilates and forms a bulge in the right superior mediastinal silhouette. The appearance of these two dilated structures has been described as "a figure-of-eight formation with the heart" or the "mediastinal moustache." Fluoroscopically the supracardiac mediastinal shadows can be seen to pulsate, but less than the engorged hilar vessels. When a pulmonary vein inserts into the right atrium, it may not be possible to distinguish it from the other hilar vessels.

Angiocardiography has been useful in diagnosing anomalous drainage of pulmonary veins. A previously unrecognized sign, a constant filling defect at the site of insertion of the anomalous pulmonary veins, which is caused by the turbulent flow of blood impinging against the contrast material, was seen in all but one of the authors' cases. The anomalous veins are frequently outlined by the contrast material. The left atrium in complete transposition of the pulmonary veins is usually hypoplastic and was not opacified directly from the right atrium through the interatrial septal defect in any instance in this series.

Fifteen roentgenograms; 7 drawings; 5 tables.
HOWARD L. STEINBACH, M.D.
University of California, S. F.

Phlebography in Old People. I. Orlandini and G. Braga. Ann. di radiol. diag. **27**: 500–523, 1955. (In Italian)

The authors report an interesting study demonstrating by means of opaque injections the changes which occur in the venous system of the extremity with advancing age. Such changes consist in alterations of caliber of the vessels, irregularity of the lumen, tortuosity, and a general decrease of the number of veins visualized.

Radiographs obtained in young, middle-aged, and old patients are reproduced, and the technic of visualization of the superficial and deep veins is discussed.

Seventeen roentgenograms.
CESARE GIANTURCO, M.D.
Urbana, Ill.

Some Aspects of the Technique in Pelvic Phlebography. T. Greitz. Acta radiol. **43**: 429–436, June 1955.

In cases of chronic venous insufficiency of a lower extremity, it is desirable to examine the external iliac vein. This can be done by several different roentgenographic methods. In this article the author reviews his experiences with pelvic phlebography by various technics in 310 cases.

About 80 per cent of cases showed good external iliac vein filling in the erect position following routine injection of contrast medium at some point below the knee. In the remainder, the best results were obtained by

making the injections through a catheter inserted into either the popliteal or great saphenous vein. In occasional cases, however, vein catheterization was unsuccessful; in these, injection may be made into the femoral vein or into a superficial vein in the lower thigh.

Nine roentgenograms. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Phlebography of the Deep Pelvic Veins Including the Inferior Vena Cava. W. M. Hilscher. Fortschr. a. d. Geb. d. Röntgenstrahlen **82**: 741–756, June 1955. (In German)

Phlebography of the deep pelvic veins was performed in 78 patients in whom obstruction was suspected clinically. In 36 cases abnormalities were found: on the left side in 24 cases, on the right side in 4, and bilateral in 6. Changes in the inferior vena cava accounted for the remaining 2. The common iliac veins were involved in 23 cases.

The author used percutaneous injection into the femoral vein and injection into the bone marrow of the pelvis. Transosseous pelvic injection was performed under general anesthesia with either nitrous oxide or intravenous barbiturates. A sternal puncture needle is introduced into the pelvis (pubis or ischium, most commonly), marrow is aspirated, and 40 c.c. of 45 to 60 per cent Perabrodil M (Diodrast) is injected rapidly with either pressure apparatus or manual pressure. The first exposure is made after the injection of the first 7 c.c., the second at the end of the injection, and the third ten seconds later. The veins on the opposite side may normally be visualized if (*a*) the site of injection is near the mid-line and (*b*) the injection pressure is great.

For percutaneous injection of the femoral vein, which is preferred by the author, local anesthesia can be used. Forty cubic centimeters of a 60 to 80 per cent solution of Perabrodil M is injected. When the interest is centered on the inferior vena cava, simultaneous injection of both femoral veins should be performed.

The combination of percutaneous injection of the femoral vein and simultaneous injection into the pelvic bone marrow on one side offers the advantage of visualization both of the internal and external iliac veins on that side.

The author had only four complications in his transosseous injections: 2 patients had fever and pain in the pubic region; 2 patients had evidence of thrombosis of some pelvic veins, presumably the result of previous transosseous injections.

Eighteen roentgenograms.

ALEXANDER R. MARGULIS, M.D.
University of Minnesota

Budd-Chiari Syndrome: Diagnosis by Hepatic Venography. A. J. Brink and D. Botha. Brit. J. Radiol. **28**: 330–331, June 1955.

A fatal case of obstruction of the hepatic vein following a crushing injury to the upper abdomen is here reported. Diagnosis was made by hepatic vein catheterization and venography. The procedure is as follows: An intracardiac catheter, introduced into the left median antecubital vein, is advanced through the right heart into the inferior vena cava and maneuvered into the left hepatic vein orifice. Under fluoroscopy, Diodrast is then injected to outline the vein and tributaries. The technic is said to be relatively simple and of considerable value for investigation of other liver conditions and inferior vena cava obstruction.

One roentgenogram. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

THE DIAPHRAGM

Primary Cyst (Mesothelial) of the Diaphragm. Report of a Case. Clarence A. Bishop and Raymond J. Lipin. J. Thoracic Surg. **29**: 577–581, June 1955.

Primary cysts of the diaphragm are rare, only 8 cases having been reported prior to this communication.

The authors' patient was a 57-year-old Negro male with a twenty-year history of upper abdominal and right shoulder pain. Roentgen examination revealed a soft-tissue mass in the left leaf of the diaphragm which moved with the diaphragm. Immediate surgery was refused but two years later a thoracotomy was done and the cyst was removed. Diaphragmatic musculature was completely absent in the area. The cyst was thin-walled, lined by a single layer of flat mesothelium and strands of fibrous tissue. It measured $6 \times 5 \times 4$ cm.

The mass shadow cast by the fluid-filled cyst was present on films made twenty years before the present episode. There had been a slight increase in size in the interval.

Mesothelial cysts ("celomic cysts") arise in different anatomical positions from various parts of the mesothelial lining of celomic cavities. They are to be differentiated from cysts originating from other embryologic structures, *e.g.*, bronchogenic, mesenteric and lymphatic cysts.

Four roentgenograms; 3 photographs.

JOHN F. RIESSER, M.D.
Springfield, Ohio

THE DIGESTIVE SYSTEM

Dysphagia Lusoria: Clinical Aspects in the Adult. Eddy D. Palmer. Ann. Int. Med. **42**: 1173–1180, June 1955.

Dysphagia lusoria is due to esophageal compression by an anomalous right subclavian artery which arises as the fourth branch of an otherwise normal aortic arch and passes around the left and posterior aspects of the trachea and esophagus, forming a vascular ring. The author reports a series of 11 cases.

Patients complained primarily of dysphagia as a daily constant problem. In some cases this was of sudden onset; in others swallowing difficulties were of gradual development over a period of years. Ordinarily solid foods were felt to come to rest beneath the sternum. Difficulty with liquids occurred if they were taken rapidly.

The diagnosis is established by the characteristic esophageal defect as demonstrated roentgenologically. The roentgen signs of pressure upon the esophagus, usually best studied in the right anterior oblique projection, are those of a pulsating, oblique extrinsic pressure defect passing upward from left to right, just above an aortic knob impression, which at times is unusually small.

Most patients were fearful of cancer and, following a simple explanation of the mechanics of their problem, along with some reassurance, made a satisfactory adjustment, needing no further therapy.

Three roentgenograms; 1 drawing.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Carcinoma of the Oesophagus Presenting Unusual Features, with a Note on Technique of Examination. P. Jacobs. Brit. J. Radiol. **28:** 317–319, June 1955.

It is possible to do a double-contrast examination of the esophagus by having the patient swallow air after taking a thin barium emulsion. Spot films are then made in deep inspiration.

By this means the author was able to diagnose an esophageal carcinoma which was not demonstrated by routine barium swallows and esophagoscopy. Other conditions such as stricture secondary to esophagitis and hiatus hernia have been similarly revealed.

Radiographs accompanying this article show how one may demonstrate the amount of distensibility of the esophagus along with some of the lesions which cause narrowing of the lumen.

Six roentgenograms. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

The Pyloric Antrum of the Stomach. Caldwell Lecture, 1954. Edward L. Jenkinson. Am. J. Roentgenol. **73:** 905–937, June 1955.

The author introduces this comprehensive account of the pyloric antrum with a review of the anatomy of the stomach, giving special attention to those structures which may play a significant role in the development of pyloric antral lesions, notably the muscle layers of the stomach and their nerve supply.

Hypertrophy of the pyloric muscle is the first pathological entity discussed. The roentgen characteristics are elongation, decrease in diameter, delay in opening, and deformity of the pyloric canal, and deformity of the duodenal bulb. The possible role played by heredity, antral spasticity, and neurogenic factors is discussed. The symptomatology of hypertrophic pyloric stenosis is described, and the difficulty of a differential diagnosis in some cases is emphasized. Several valuable differential diagnostic points are given.

Antral gastritis is next considered. The roentgen diagnosis of this condition is based on a close study of the mucosal pattern of the empty stomach. A granular appearance, irregular translucencies, abrupt changes in direction, and break in continuity of the mucosal folds may be due either to carcinoma of the antrum or chronic hypertrophic gastritis. A violent break in the contour usually means cancer; rugosity, stiffening, and widening of the folds with preservation of the pattern suggest gastritis. Grape-like polyps in the antrum may be either neoplastic or inflammatory. Wart-like elevations may be widespread and often arise from an atrophic mucosa. A cobblestone appearance with streaks of barium between and around the elevations may be noted.

Chronic hypertrophic gastritis is a common roentgenographic diagnosis. The gastroscopist believes that the only roentgen sign of value is a nodular or corncob mucosal pattern and that the changes which are most reliable are those associated with the giant type of the disease.

Evidence of antral gastritis is difficult to elicit. Since few cases come to operation, the diagnosis is infrequently proved by microscopic study.

Prolapse of the gastric mucosa into the duodenum is not infrequent. The demonstration of a cauliflower-shaped defect in the base of the duodenal bulb and the extension of gastric folds from the pyloric canal into the bulb warrant a diagnosis of prolapse. There may be hypertrophy of the gastric rugae. The condition must be differentiated from pressure or overlap of the pyloric valve, pedunculated polyps, and induration associated with ulcer or duodenal inflammatory changes.

The accurate diagnosis of gastric lesions may be rendered more difficult by *extragastric abnormalities.* The most common of these are congenital bands and adhesions. The deformities produced by such bands are constant and unaffected by antispasmodics. The radiographic picture may vary in minor details, but consists essentially of distortion of antral outline, luminal narrowing, and sometimes inhibition of peristaltic waves. Differential diagnosis is often impossible, and operation may be necessary. Fixation of the stomach suggests an extragastric lesion, but fixation plus gastric deformity may be indicative of extension of intragastric disease into the surrounding tissues.

Seventy-five per cent of *gastric carcinomas* are found in the antrum. The onset is insidious and the best chance of cure is early diagnosis. The roentgenologic classification is as follows: (1) scirrhous-type, which may be localized or diffuse; (2) encephaloid or fungous type; (3) malignant ulcer. The author discusses the roentgen findings associated with the different types and stresses the value of the meniscus sign in detecting early cases. Many useful points in arriving at a differential diagnosis are recorded, but often an accurate differential diagnosis cannot be made even after all pertinent diagnostic data are assembled and evaluated.

Sarcoma of the stomach is seldom diagnosed preoperatively as it very closely resembles carcinoma roentgenoscopically and roentgenographically.

The benign pyloric ulcer presents different roentgen features than ulcers elsewhere in the stomach. The direct signs are a small, shallow crater, which may take the form of a spicule or a tiny diverticulum. A rosette appearance with a central fleck and radiating plicae are noted when the ulcer is seen *en face.* The crater may extend into the duodenal bulb and deformity of this structure may be noted also. The indirect signs are pylorospasm, pyloric stenosis or obstruction, coarse irregular mucosal folds, and achalasia. The benign gastric ulcer must be differentiated from gastric cancer, duodenal ulcer, cholecystitis, pancreatitis, renal or appendiceal lesions, and hypertrophic pyloric stenosis.

This long, detailed paper, covering many aspects of what is generally considered the most common site of functional and organic lesions of the stomach, cannot be fully abstracted in the space available here. In the foregoing summary, attention has been devoted mainly to the roentgen aspects.

Twenty-one roentgenograms. H. C. JONES, M.D.
Grand Rapids, Mich.

Modified String Test for Determination of the Site of Upper Gastrointestinal Bleeding. Emanuel M. Rappaport. Gastroenterology **28:** 1016–1026, June 1955.

The use of the modified Einhorn string test in selected cases of gastrointestinal bleeding can be a valuable adjunct to standard x-ray and endoscopic procedures.

A four-ply white wool yarn, 33 inches long, weighted at one end, and knotted 30 inches from this end, is swallowed by the patient. The knot is taped to the angle of the mouth. The cardio-esophageal junction is considered to be 16 inches, the antrum 21 to 23 inches, and the duodenal bulb 24 to 25 inches from this point, though the distances vary considerably in different subjects.

Testing is done at night with the patient fasting, and the string is removed the following morning. The location, color and length of any blood stain is noted, and their significance discussed. Since the problem concerns only recent bleeding, testing the yarn for occult blood is unwarranted. A stain must be several inches or more in extent to be considered significant. Short stains occasionally were noted at levels believed to represent the cardio-esophageal junction and pylorus; these stains presumably resulted from trauma.

The test has numerous limitations. Obviously, it is of no value during massive bleeding, with pooling of blood in the stomach. Even during bleeding of a relatively minor degree, blood saturation of a considerable length of yarn may prevent accurate appraisal. If bleeding has completely terminated, a negative test will result.

In elderly patients, multiple potential sites of hemorrhage are not uncommon, due to the frequency of both hiatus hernia and duodenal ulcer. In one such patient, dense black staining from 17 to 22 inches indicated bleeding limited to the upper stomach; the distal string was never blood-tinged.

While the test occasionally was helpful in localizing bleeding sites in the esophagus or cardia, it generally was unreliable in instances of bleeding from the lower stomach or duodenum. By rendering the distal 12 inches of yarn radiopaque, its position prior to removal could be radiographically determined, enhancing accuracy in the pyloric area.

While not recommended for routine use, the string test used selectively and serially may prove helpful in suggesting a site of recurrent bleeding when x-rays have repeatedly failed to demonstrate a definite cause, when multiple lesions are found or suspected, and to prove or disprove occult bleeding from an upper gastrointestinal site.

Three case reports are presented.

Four roentgenograms; 1 photograph.

C. M. GREENWALD, M.D.
Cleveland Clinic

Roentgenological Studies of Gastric Secretion in Children. Franz J. Lust. Am. J. Gastroenterol. **23**: 575–581, June 1955.

For roentgen examination of the upper gastrointestinal tract in children, the author uses the fractionated chocolate-flavored barium meal. After the first 2 ounces the child lies on a soft couch, turning on each side for a few minutes. A prone film is then taken. The pylorus is usually found open at this time. Another 3 ounces of the barium suspension is given and films are taken in the prone, prone-oblique, and erect positions. The films are then reviewed, minimizing the time required for fluoroscopy. A head fluoroscope (Belloscope) obviates the need of darkness, which may be frightening to young patients. A film of the stomach and small bowel ends the immediate study and the child is allowed to eat. Two- and six-hour films are obtained. Spot films may be taken as necessary.

The author's study of gastric secretion is done with the aid of barium. A film obtained twenty minutes after administration will show an area of diminished density above the barium shadow. This represents the secretion due to the stimulus of the ingested contrast substance. A comparison is made with the observations on sedimentation of barium in a test tube or glass reproduced simultaneously on the roentgen film. Estimation of the amount of secretion by this means obviates the necessity of gastric analysis and the attendant passage of a tube.

The presence of flocculated, rounded masses of barium above the homogeneous mass is attributed to the presence of excess mucus in the stomach. This mottling of barium is seen in various conditions, *e.g.*, post-nasal drip, peptic ulcer, and after oral administration of antibiotics.

Nine roentgenograms; 1 photograph.

SAUL SCHEFF, M.D.
Boston, Mass.

Clinical and Radiological Remarks Regarding Neoplasms of the Gastric Fornix. Carlo Rimondini. Radiol. med. (Milan) **41**: 540–562, June 1955. (In Italian)

The author reviews a series of 1,915 esophageal and gastric neoplasms seen between 1950 and 1954 at the University of Bologna; 312 (16.3 per cent) involved the gastric "fornix" (*i.e.*, abdominal esophagus, cardia, and fundus). Seventy-five per cent of the patients were males. The maximum incidence was in the sixty-to-seventy-year age group. Dysphagia (often the first sign), loss of weight, and anorexia were frequent clinical findings. There was seldom distaste for specific foods and vomiting was infrequent.

The area is inaccessible to palpation, barium does not fill it in the erect position, there is extreme variability in the (irregular) mucosal design, and peristalsis cannot be evaluated, thus eliminating most of the aspects used in the diagnosis of cancer elsewhere in the stomach. Examination of the fundus has often been recommended, prior to ingestion of barium, to determine (1) absence of the gas bubble, (2) presence of polypoid masses, and (3) widening of the space between bubble and diaphragm caused by infiltration of the stomach wall. Of greater value, in the author's experience, is the demonstration, in upright fluoroscopy, of fragmentation (aspect of "torrent flowing over rocks," bifurcation, trifurcation, polyfurcation) of the barium swallow after it passes the cardia, which should be confirmed by spot films. One should also look for extension of the tumor toward the esophagus (spiral appearance due to retraction) and toward the lesser curvature (filling defects). Filling defects in the fundus are demonstrated only in decubitus, preferably supine.

For best results, the author recommends a double-contrast procedure (barium suspension followed by a carbonated drink). He also used body-section radiography after pneumoperitoneum, but this was found to provide little additional information beyond establishing the presence or absence of adhesions between stomach and diaphragm.

Conditions to be differentiated include: (1) paracardial lymphadenopathy, (2) splenomegaly, (3) enlarged left lobe of liver, especially when irregularly outlined, (4) subphrenic abscess, (5) interposition of the colon, (6) ulcer of the gastric fundus, and (7) esophageal and gastric varices.

Between October 1948 and April 1954, 94 total gastrectomies were performed for cancer of the "fornix." In 84 cases almost the entire stomach was involved; in 10 the process was still localized about the cardia. In 64 patients, a combined thoracic and abdominal approach was used, in 30 the abdominal route only. There were 32 (34 per cent) surgical deaths. Thirty-eight patients died subsequently, 16 were well at the

time of the report, and 8 were untraced. Only 4 had survived two years or more after operation.

Thirty-four roentgenograms.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Myo-epithelial Hamartoma of the Stomach. William S. Haubrich. Gastroenterology **28**: 1027–1033, June 1955.

One of the benign lesions which may simulate malignant neoplasia in the stomach is myo-epithelial hamartoma, otherwise called aberrant or heterotopic pancreatic tissue. A report of a case in a sixty-year-old woman is presented, and 16 almost identical lesions previously recorded in the literature are reviewed. No doubt numerous other examples are included among cases designated as "aberrant pancreas" or "gastric pseudodiverticulum," in which detailed descriptions of histologic characteristics are lacking.

Thirteen of the 16 cases reviewed occurred in men. The age range began with infancy, but the majority of patients were in the fifth and sixth decades. Complaints were nondescript; hemorrhage had occurred in only one case. The lesions were always in the distal antrum, almost invariably on the greater curvature, and ranged from 0.5 to 4.0 cm. in greatest dimension. X-rays proved helpful in delineating size, configuration, and location, but gave no hint of histologic structure. At surgery, the gross morbid anatomy is characteristic, and with such recognition simple segmental excision would seem the procedure of choice. In no case was any tendency to malignant growth evident.

Grossly, either the nodule of aberrant tissue or a pseudodiverticulum may be the predominant feature, the latter varying from a dimple to a relatively capacious pocket. This "diverticulum" was radiographically apparent in 4 cases. Histologically, the two components of hyperplastic smooth muscle and epithelial elements are readily recognized, varying in preponderance.

One roentgenogram; 2 photomicrographs; 1 drawing.

C. M. GREENWALD, M.D.
Cleveland Clinic

Generalized Gastrointestinal Polyposis. An Unusual Syndrome of Polyposis, Pigmentation, Alopecia and Onychotrophia. Leonard W. Cronkhite, Jr., and Wilma Jeanne Canada. New England J. Med. **252**: 1011–1015, June 16, 1955.

The authors summarize the literature on generalized gastrointestinal polyposis and find that only a superficial classification of these cases into familial and non-familial types is tenable. In the familial group fall the cases of "polypoid adenomatosis of the colon" without pigmentation and the "Peutz-Jeghers syndrome," in which the intestinal polyps are associated with melanin spots on the oral mucosa, lips, and digits. In these heredity-linked groups the lesions usually appear at adolescence and not later than the third decade.

The 2 cases reported here fall in the non-familial classification. In addition to diffuse polyposis, the patients showed loss of scalp and body hair, diffuse brown pigmentation with a distribution unlike that seen in familial cases, and changes in the nails. The first patient was a 42-year-old spinster with a negative past history who went downhill rapidly and died of "starvation" eight months after the onset of symptoms. The second was a 75-year-old widow who had been treated for pernicious anemia for nineteen years preceding the onset of low abdominal cramps accompanied by intermittent diarrhea with blood and mucus. She survived some eighteen months. The ectodermal changes are attributed to the widespread deficiency state resulting from malabsorption from the altered mucosa of the lesion-ridden intestine.

Gastric, duodenal, and colonic polyps are easily demonstrated; the small intestinal lesions are difficult to show. The pedunculated polyps are usually single; the sessile polyp is more frequently seen in diffuse polyposis and is represented roentgenographically by a diffuse, coarse, but characteristic mottling.

Seven roentgenograms.

SAUL SCHEFF, M.D.
Boston, Mass.

The Theoretical and Practical Significance of Peri-ulcerous Inflammation. E. Ötvös. Acta med. (Budapest) **8**: 141–162, 1955.

The author describes the "atropine test," introduced by him in 1920, and affirms its value for the roentgen recognition of the inflammatory wall changes which accompany peptic ulcer. If confirmed, this would represent a significant diagnostic contribution, since perigastritis and periduodenitis are commonly encountered by the surgeon or pathologist.

In cases of chronic ulcer, gastric emptying is often protracted, in spite of lively peristalsis. The evacuation time may, however, be normal, and it is in such cases that the test is said to prove its value, as the emptying time will be delayed under the influence of atropine. In the absence of inflammatory wall changes (*i.e.*, in patients with superficial, fresh, or healed ulcer, or no ulcer at all), emptying time will not be influenced. This is explained by the effect of chronic inflammation upon Auerbach's plexus, with alteration of the atropine-choline barrier.

The atropine test should be performed a few days after the regular barium meal, to afford a base line for comparison. About thirty minutes before the examination, 1.0 mg. of atropine sulfate is injected subcutaneously. The contrast material is given after onset of the systemic reaction (dryness of the mouth, tachycardia, mydriasis). The test is considered frankly positive when, in the presence of intensive peristalsis, there is more than one-third gastric residue after two hours. Shallow peristalsis or a 25 per cent two-hour residue may cause difficulties in evaluation; nor can the result be evaluated properly when there is interference with pyloric mechanisms (pylorostenosis), although some figures may be obtained by comparison with the time of evacuation in the absence of atropine. Attention must be paid to possible general contraindications for the use of atropine, as, for instance, glaucoma.

In practice, the atropine test is recommended (1) to solve a purely diagnostic problem, *e.g.*, when a persistently deformed duodenal cap causes complaints; (2) to guide the radiologist in the follow-up of a known ulcer case (the test should become positive when a fresh ulcer starts to penetrate deeper layers); (3) as a research tool.

Brief comments are made upon "a total of 580 atropine tests performed in more than 380 patients examined in the period 1951–1954." In 50 of these cases "the behavior of the test was followed in serial studies carried out at intervals sometimes as long as two years."

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Radiological Findings in Patients Subjected to Antroduodenectomy for Duodenal Ulcer. P. H. Davis. Australian & New Zealand J. Surg. **24:** 268–271, May 1955.

Sixty-two of 81 patients undergoing antroduodenectomy for ulcer were examined with a barium meal within six months preceding operation. The radiological findings were basically correct in 54. In 6 patients, ulcers which proved to be duodenal were thought to be antral. In 2 cases a duodenal ulcer was not found radiologically. An ulcer niche was reported in 21 patients; yet all but one case showed one or more craters in the resected specimen.

Since antroduodenectomy is advised only for ulcers in the proximal part of the first portion of the duodenum, estimation of the distance between the ulcer and the pyloric canal is of considerable importance.

The author's experience shows the difficulty of demonstrating an ulcer niche in scarred areas of the duodenum and of finding multiple ulcers.

Three roentgenograms; 3 photographs; 1 table.

D. D. ROSENFELD, M.D.
Oakland, Calif.

A New Radiographic Sign in the Obstruction of the Terminal Ileum. L. Arrieta Sánchez. Radiología (Panama) **5:** 87–94, June 1955. (In Spanish)

The author presents 6 cases in which he has observed a new radiological sign valuable in the diagnosis of obstruction of the terminal ileum. This sign can be visualized on a single film of the abdomen with the patient in the upright position. It consists of dilatation by gas of one or two small bowel loops, which appear in the form of a "U" or an inverted "U" or arch segment, frequently localized in the left upper quadrant. The dilatation of the loops is explained by diffusion of the blood gases and by diminution of the absorptive capacity of the mucosa. No further explanation is offered.

Surgery demonstrated the following causes of obstruction: (1) strangulation by adhesions following previous operation (2 cases); (2) Meckel's diverticulitis, acute with adhesions (1 case); (3) acute appendicitis with adhesions (1 case); (4) volvulus associated with Meckel's diverticulum (1 case); (5) suppurative acute appendicitis with abscess in the tip (1 case). In 3 cases the obstruction was only partial.

Six roentgenograms. FABIO SALCEDO, M.D.
St. Vincent's Hospital, New York

Inflammatory Lesions of the Colon Simulating Neoplasms. Charles D. Branch and Claire B. Sledge. Gastroenterology **28:** 981–989, June 1955.

Twelve cases of localized lesions of the colon resulting from regional colitis are discussed by the authors, and the historical background of this relatively uncommon condition is reviewed.

In the present series, the ages of the patients were greater (average fifty-eight years) than those usually reported for ulcerative colitis. Six of the 12 lesions were in the cecum, 3 in the descending colon, and 3 in the sigmoid. The most common symptoms were abdominal pain and cramps, probably due to the presence of partial or complete obstruction. Four patients had gross bleeding. Roentgenographically the cecal lesions appeared hyperplastic. There was narrowing of the lumen in the left colon lesions, which for the most part involved only a small segment. Although no napkin-ring configuration was seen, the differentiation between a neoplasm and inflammatory lesion could not be made preoperatively, and the presumptive diagnosis in all 12 instances was carcinoma. Even at surgery, with the abdomen opened and the lesion visualized, differentiation from carcinoma was difficult in some instances. Resection was performed in all cases. Follow-up study revealed no evidence of recurrence in the 10 living patients.

Two pathologically different, non-specific chronic infections of the colon previously described in the literature are briefly reviewed. One is similar to terminal ileitis, termed *regional* or *cicatrizing enterocolitis;* the other is segmental or regional ulcerative colitis. Both are of unknown etiology, and in the later stages the dividing line becomes obscure. In the present series, separation was not accomplished, the pathologic diagnosis being chronic, non-specific inflammatory disease.

The authors believe that all of these cases of segmental colitis will progress until complete obstruction develops, necessitating colostomy and later a resection of the primary lesion. Because of the tendency to progression, the difficulty in differentiation from carcinoma, and the failure of follow-up studies to show further involvement of the colon by a similar lesion following resection, radical removal of the bowel segment in question is deemed mandatory.

Two roentgenograms; 2 photomicrographs; 1 photograph. C. M. GREENWALD, M.D.
Cleveland Clinic

Preliminary Observations on Veripaque, a Colonic Actuator for Use with Barium Enemata. J. W. McLaren, J. B. King, and W. A. Copland. Brit. J. Radiol. **28:** 285–294, June 1955.

The authors here present a technic whereby the colon is both filled and emptied under fluoroscopic observation. Veripaque, a colon actuator, is mixed with the barium enema and appears to increase gently the vigor and speed of normal colonic movements. A good functional colon study is obtained in this manner, and in addition, an excellent mucosal pattern is produced.

Excellent descriptions of the appearance and sequence of the movements of the colon are given under both normal and various abnormal conditions.

In normal colon evacuation there is an initial symmetrical narrowing just distal to the cecum, accompanied by a prominent rising upward of the cecum. The contraction spreads to the upper ascending colon and to the cecum, which may momentarily become more fully filled before it contracts in turn. Another segmental contraction then occurs in the proximal transverse colon or cecum, or at both sites simultaneously. Once the ascending portion is emptied, the transverse colon tends to undergo an extensive segmental contraction and, at the same time, early contractions may appear in the lower descending colon. A longitudinal shortening of the entire colon is seen, with unfolding of its more tortuous loops. A dependent transverse colon will rise, the splenic flexure may descend, and the overlapping sigmoid loops shorten and unfold themselves in the pelvis.

The effects of various pathological entities upon these sequential movements are excellently presented both in text and in illustrations.

The authors suggest that in colon studies emphasis should probably be placed upon the appearance of the

colon during evacuation rather than during filling. Indeed, the method as here presented would seem to represent a real advance. Veripaque is evidently a valuable radiological adjuvant. The active constituent of the preparation used by the authors was dihydroxyphenyl isatin.

[In a communication to the *British Medical Journal* (**2**: 617–618, Sept. 3, 1955), Norman P. Henderson reported less favorable results with veripaque. It was claimed by the manufacturers, however (Brit. M. J., Sept. 24), that the preparation used by Dr. Henderson was not that employed by McLaren and his associates. —Ed.]

Twenty-six roentgenograms.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Sarcoidosis of the Rectum. A. R. McGee and C. R. Rapp. J. Canad. A. Radiologists **6**: 29–32, June 1955.

Boeck's sarcoid, sarcoidosis, Besnier's disease, and Schaumann's disease are names which refer to the same clinical entity. Of these, sarcoidosis is the most generally used. Sites of involvement include skin, lymph nodes, myocardium, endocardium, pancreas, testes, and bone marrow. Presence of the disease in the adrenal gland has been suspected, and recently a case with apparent obliteration of the pituitary gland has been published (Owen and Hennerman: Brit. M. J. **2**: 1141, 1954). Only rarely has sarcoidosis been reported as involving the intestinal tract.

The authors record the case of a 26-year-old male with a history of chronic constipation for four years and ribbon-like stools for about two years. Digital examination revealed a firm locular mass on the posterior and lateral aspects of the rectum, causing almost total occlusion by encroachment on the lumen. A barium enema study showed irregular narrowing of the rectum with normal bowel above. Through the sigmoidoscope the rectum appeared firm and thickened, particularly posteriorly, with a fixed nodule, the size of a walnut, protruding into the mid-line. The biopsy report was "sarcoidosis of the rectum."

A Devine defunctioning colostomy was performed, and the rectum was palpated. There were no enlarged regional lymph nodes and no diverticula, nor was any disease of the abdominal viscera found. Three months after discharge, a barium enema study failed to show any improvement, but two years later the rectum was completely normal, with no evidence of the original disease. At the time of the report the patient had been asymptomatic for three years.

No other case of sarcoidosis of the rectum could be found in the literature.

Three roentgenograms; 2 photomicrographs.

FRANK T. MORAN, M.D.
Auburn, N. Y.

Major Undesirable Side-Effects Resulting from Prednisolone and Prednisone. Alfred Jay Bollet, Roger Black, and Joseph J. Bunim. J.A.M.A. **158**: 459–463, June 11, 1955.

This paper reports 3 cases of major undesirable side-effects observed in a series of 18 successive cases of rheumatoid arthritis treated with Prednisolone and with Prednisone. These new synthetic steroids, formerly known as Metacortandrolone and Metacortandrocin, respectively, have been found to be four times more potent than cortisone in suppressing the inflammatory joint changes of rheumatoid arthritis. Some minor undesirable effects are facial rounding, hirsutism, diminished carbohydrate tolerance, insomnia, restlessness, weakness, transitory mental clouding, acne, increased skin pigmentation, and vague abdominal distress. The major side effects encountered were the appearance of duodenal ulcer in 3 patients and the development of a depressive psychosis in one of them. The ulcers were asymptomatic, at least during the early stages, and were discovered in the course of a routine gastrointestinal examination done as part of the planned study. Two of the 3 patients had normal gastrointestinal series prior to steroid administration. In the third no pretreatment films were available.

In patients with rheumatoid arthritis under treatment with cortisone or cortotropine, the incidence of peptic ulcer appears to be quite low when the drug is given for only a short time. With long periods of administration the ulcer incidence apparently rises. In an accumulation of cases from the literature thus treated, this complication was found in 7.5 per cent. In the present series of 18 patients treated with Prednisolone and Prednisone for periods of from one to seven months, 3 showed radiologic evidence of peptic ulcer; none of these had an ulcer history.

There was no apparent relation between the duration of treatment with Prednisolone or Prednisone, or the total dose of the drug, and the appearance of ulcer. A total dose of 1.9 gm. (Prenisolone and Prednisone were given at different times) was administered to one patient, in whom an ulcer was present on the seventieth day of treatment. In the second case, more than 3 gm. of the drugs was given and an ulcer appeared at the end of the third week of a third course, the total treatment having been carried on intermittently for several months. The dose in the third case was 600 mg. of Prednisone, and ulcer was present on the twelfth day.

If this unusually high incidence of ulcer is substantiated by a larger series, it will indicate added caution in the use of these drugs. Radiologic evidence of healing within three weeks following institution of the usual medical anti-ulcer measures, including aluminum-hydroxide gel, occurred in 2 of the patients who were maintained on an unreduced dose of the steroids. The third case showed improvement on a similar medical regime and cessation of the drug. The authors suggest that it is possible that the prophylactic administration of aluminum hydroxide gel might reduce the incidence of peptic ulcer in cases treated with these steroids.

Three roentgenograms; 1 graph; 1 table.

F. F. RUZICKA, JR., M.D.
St. Vincent's Hospital, New York

Intussusception of Appendiceal Mucoceles. Bernard P. Adelman and J. George Teplick. Am. J. Roentgenol. **73**: 966–970, June 1955.

The rare combination of appendiceal mucoceles with intussusception into the cecum is illustrated by 2 cases, making a total of 16 reported to date. A brief discussion of the possible etiologic mechanisms is given. The mucocele results from obstruction of the appendiceal lumen without associated infection. Most commonly the base of the appendix invaginates into the cecum to produce the intussusception.

Appendiceal mucocele with intussusception occurs only in adults. There is usually a long history of lower abdominal or peri-umbilical cramp-like intermittent pain with intervals of complete relief. Nausea, vomit-

ing, melena, and a palpable mass are likely to be present, although not necessarily so.

Radiologically a mucocele may be suspected in the presence of displacement or deformity of the cecum. Occasionally it may contain calcification. With superimposed intussusception, a cecal mass and ring-like shadow may be demonstrated by a barium enema. The appendix, of course, is never visualized, but visualization of a normal terminal ileum excludes that as the origin of the intussusception. If the intussusception is large enough to block the ileocecal valve, findings of intestinal obstruction will also be present. Examination during an asymptomatic period can be expected to be normal.

Despite fairly reliable signs and symptoms, together with the radiographic findings, the authors feel that few preoperative diagnoses of this condition will be made, first because of its rarity and, second, because a mass in the cecum is rightly regarded as carcinoma until proved otherwise.

Four roentgenograms.

J. A. GUNN, M.D.
Grand Rapids, Mich.

Nonparasitic Cystic Disease of the Liver. Ramon A. Sifre, Harvey W. Phelps, Norman J. Cole, and Cecil H. Kimball. Ann. Int. Med. **42:** 1288–1297, June 1955.

Non-parasitic cystic disease of the liver is a comparatively rare pathologic entity. The cysts usually give rise to no symptoms and are discovered merely by reason of their size. When, symptoms are present, they are for the most part due to pressure upon neighboring organs, hemorrhage into the cyst, torsion of its pedicle, inflammation and rupture. Pain in the right upper quadrant of the abdomen or in the epigastrium is frequently described. Nausea and vomiting may occur secondary to pressure upon the stomach or duodenum. If the cyst is large enough to produce symptoms, there is a good possibility that it should make its presence known by means of extrinsic pressure defects upon the stomach, gallbladder, and other structures.

In the case reported, roentgen examination revealed an extrinsic pressure defect on both the gallbladder and the duodenal cap. At operation numerous cysts were found scattered throughout the substance of the liver. Four of these were excised; one showed adhesions to the duodenum. The largest single cyst measured 9.5 cm. in diameter.

Three roentgenograms; 1 photograph; 2 photomicrographs.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Stones in the Common Bile Duct: The Role of Operative Cholangiography. E. S. R. Hughes. M. J. Australia **1:** 820–823, June 4, 1955.

The author reviews a series of 100 operative cholangiographic studies. In 80 the examination was a routine procedure following cholecystectomy, in 11 cases it was performed during re-exploration of the common bile duct, and in 9 it was done during miscellaneous operative procedures.

A film is taken after the abdomen is opened. If stones are removed from the common duct, a second film, or "control operative cholangiogram," is then obtained to indicate whether all the calculi have been removed. For routine operative cholangiography a ureteral catheter may be inserted in the common duct through the cystic duct or, if the gallbladder has been previously removed, the common bile duct may be punctured anteriorly with a long needle and a direct injection made. A tunnel under the patient is suggested for easier insertion and removal of the cassettes. Ten to 15 c.c. of contrast medium is used.

The most disappointing feature in this study was the difficulty of interpreting the films. Calculi do not always produce a classical filling defect, but may occur in apparently normal ducts or in ducts that are only slightly dilated or they may prevent contrast medium from entering the duodenum. In 3 cases, a report of no calculi was found to be incorrect on re-exploration. In 4 cases, calculi were reported but exploration and follow-up studies showed the shadows to be due to gas bubbles. In 3 cases, common duct stones were discovered which would otherwise have been overlooked.

Despite the failures reported, it was felt that the procedure was a valuable one if used in conjunction with other available evidence.

One roentgenogram; 2 tables; 1 drawing.

EMIL H. SCHNAP, M.D.
Buffalo, N. Y.

The Indications for Intravenous Choledochography: Preliminary Report. W. S. C. Hare. M. J. Australia **1:** 823–826, June 4, 1955.

The results in the first 50 cases examined at the Royal Melbourne Hospital with Biligrafin (Cholografin) are shown to be comparable with results obtained by previous investigators. In 36 patients the gallbladder had been removed; of the 14 with the gallbladder *in situ*, 11 showed clinical evidence of common bile duct obstruction.

A test dose of 1 c.c. of the contrast medium was given intravenously one hour before the examination. For each examination 40 c.c. was used and films were taken twenty, thirty, and forty minutes after injection. Further views were obtained as deemed necessary on viewing the wet films. In 38 cases, sufficient contrast medium was present in the common bile duct to be of diagnostic value. In the remaining 12 cases, where visualization was inadequate, failure was attributed chiefly to impairment of liver function.

Bile-duct stones were demonstrated in 6 patients and proved by surgery in 5. The sixth refused operation. Evidence of gallbladder calculi was obtained in 7 cases and had been confirmed in 5 by laparotomy.

The author suggests that, because of the frequency of unsuspected common duct stones in gallbladder disease, intravenous choledochography should replace oral cholecystography. However, because of the time required for the intravenous study, he believes that preliminary examination in every case should be by the oral method. Those patients in whom calculi are demonstrated should then be re-examined by the intravenous procedure for calculi in the ducts. Also, all cases showing non-filling of the gallbladder on oral cholecystography should be subjected to choledochography, since this would confirm the presence of calculi, which are usually present in such cases.

One table.

EMIL H. SCHNAP, M.D.
Buffalo, N. Y.

Visualization of the Biliary Tract in Nurslings (Preliminary Report). T. Valledor, F. Aguirre, L. Borbolla, C. Satanowsky, and S. De Lamerens. Rev. cubana de pediat. **27:** 351–362, June 1955.

In 16 of 19 children visualization of the gallbladder

was obtained with intravenous Biligrafin. Eight of those in whom the gallbladder was demonstrated were under one year of age; one was only thirty-seven days old. Of the 3 patients in whom the biliary tract was not visualized, 1 had atresia of the bile ducts; in another there was deep liver damage and the medium was eliminated through the urinary tract. In the third, the dose was insufficient because of difficulties in venipuncture.

In 5 cases the dose was 3.5 c.c. of 50 per cent Biligrafin solution (*Biligrafin forte*); in the rest 4 c.c. of a 20 per cent solution. In 14 cases the gallbladder became visible within the first two hours. Maximum visibility was reached within two to three hours. The cystic duct was demonstrated in 3 cases. The rest of the bile ducts were not seen. An enema twelve hours before the test and insertion of a permanent rectal catheter were routine preparatory measures. Prostigmin (0.03 c.c. of a 1:2000 solution per kilogram) was administered fifteen minutes before injection of the medium. No toxic effects were observed.

In the opinion of the authors this technic opens new possibilities in the diagnosis of certain biliary diseases in infancy.

JAMES T. CASE, M.D.
Santa Barbara, Calif.

THE SPLEEN

Splenic Hemorrhage Following Percutaneous Splenoportography. Telfer B. Reynolds, William Mikkelsen, and Allan G. Redeker. J.A.M.A. **158:** 478, June 11, 1955.

The danger of serious hemorrhage following needle puncture of the spleen for splenoportography is emphasized in this brief paper. The authors report a case in which the degree of hemorrhage necessitated splenectomy and cite 2 other cases in which bleeding was less marked. They also refer to 2 serious cases from the literature.

The case reported is that of a 32-year-old woman with hepatosplenomegaly who was seen with severe microcytic hypochromic anemia which was attributed to persistent menometrorrhagia. Slightly prolonged clotting time was the only other abnormal laboratory finding. Wedge biopsy of the liver showed no abnormalities other than large sinusoids and hepatic and portal venous channels.

Because of suspicion of possible angiomatous disease of the liver causing portal obstruction, percutaneous splenoportography was undertaken. With an 18-gauge needle, 30 c.c. of 70 per cent Urokon was injected into the spleen in about nine seconds. The intrahepatic portion of the portal vein was well visualized and appeared normal. The patient held her breath satisfactorily during the splenic puncture and during the injection. Manual pressure on the abdominal wall in the splenic area was maintained for ten minutes after the needle was removed, and the patient remained flat in bed. Within one hour she complained of left shoulder pain and distress in the left upper quadrant. At operation, twelve hours after splenoportography, 1,500 c.c. of liquid blood was found in the peritoneal cavity; a large hematoma distended the splenic capsule over its entire outer surface, and blood was oozing from a 3 to 4 mm. needle rent in the lower pole. The spleen was removed. It weighed 740 gm. and microscopically was not remarkable.

The authors recognize the value of splenoportography in certain instances. Since, however, hemorrhage may result, facilities for splenectomy should be available.

F. F. RUZICKA, JR., M.D.
St. Vincent's Hospital, New York

THE MUSCULOSKELETAL SYSTEM

Linear Growth of Long Bones of Extremities from Infancy Through Adolescence. Continuing Studies. Marion M. Maresh. Am. J. Dis. Child. **89:** 725-742, June 1955.

In 1943, the author published a preliminary report on the growth of the major long bones of the extremities in healthy children (Am. J. Dis. Child. **66:** 222, 1943. Abst. in Radiology **43:** 203, 1944). This investigation has been continued, with use of the same roentgenographic technic. The number of sets of films on each subject ranges from under ten for the infants and young children to over twenty-five for those who are now adolescent or skeletally mature. Tables are presented giving the bone lengths obtained from about 1,600 roentgenograms of the left arm and leg on boys and an approximately equal number of roentgenograms on girls.

In infancy, growth in length was seldom along channelled zones as set up from the percentile lines. Instead, the rate of growth of one or more of the long bones of the extremities was sometimes faster than that of the group average, sometimes slower, and sometimes revealed periods of either temporary acceleration or deceleration.

Beginning at about three or four years of age and continuing to the prepubescent years, the childhood patterns of long-bone growth were found to be remarkably stable and orderly.

The adolescent years are again a period of more turbulence, with variations in the onset, the magnitude, and the duration of the adolescent growth spurt, along with what appears to be the emergence of variations in segmental proportions that will be part of adult body build. A comparison of heights during childhood and at the end of long-bone growth shows a good degree of correlation, with about half of the group having early adult heights that were not more than 2.5 cm. different from the values that were predicted. If, however, the data are separated into two groups—for children maturing at earlier than average age and those who were later than average in maturing—significant differences were found. The hypothesis seems to be verified that, in general, the early-maturing child will probably be shorter and the late-maturing child will probably be taller than anticipated from the childhood height.

Eight graphs; 7 photographs; 7 tables.

Significance of Skeletal Lesions in Infants Resembling Those of Traumatic Origin. Paul V. Woolley, Jr., and William A. Evans, Jr. J.A.M.A. **158:** 539-543, June 18, 1955.

It is not unusual to see infants with skeletal lesions that resemble those due to trauma but for which no explanatory history of injury is obtained. These have been recorded in the literature chiefly as two syndromes of unknown etiology: first, chronic subdural hematoma with fracture of the long bones; secondly, increased metaphyseal fragility of infancy. The authors have reviewed the case material presented at the Children's Hospital of Michigan during an eight-year interval, including all infants admitted or treated in the

emergency section because of injury during the period 1946–54, as well as infants with roentgenologic or clinical findings resembling those usually associated with trauma, even though no supportive history was obtained. In addition, all x-ray films representative of various forms of bone disease encountered during infancy were restudied in order to determine where confusion in interpretation might arise between them and examples known to be due purely to adverse lines of force. There is a very complete discussion of the variable factors relating to infant trauma and the environmental elements of each home. Detailed data on 12 cases are presented in tabular form. The authors draw four broad conclusions: "1. A history of injury in any clinical category of skeletal damage may be readily obtained, elicited only with difficulty, or not confirmed at all. There are no roentgenologic criteria for classifying cases on the basis of a presence or absence of a valid story for violence.

"2. The general environmental factors surrounding infants who suffer osseous discontinuity range from 'unavoidable' episodes in stable households, through what we have termed an unprotective environment, to a surprisingly large segment characterized by the presence of aggressive, immature, or emotionally ill adults.

"3. There is little evidence, clinical or roentgenographic, supporting belief in unusual fragility of bone as an entity during infancy, or of any peculiar association between subdural hematoma and increased skeletal fragility. Little evidence was found for confusion between various recognized clinical states leading to a hypothetic increased tendency to fracture and the multiple skeletal defects that appear grossly to be due to unrecognized trauma.

"4. A study of 12 infants presenting multiple areas of bone damage, which appeared to have accrued over an extended period of time and for which no easily elicited story of injury was available, shows that they came invariably from unstable households with a high incidence of neurotic or frankly psychotic behavior on the part of at least one adult. When these infants were removed from such surroundings and treated as if their defects were due to adverse stresses, healing took place promptly and new lesions did not develop. The incidence of injury to tissues apart from the skeleton was much higher than would be expected fortuitously. . . . It is difficult to avoid the overall conclusion that skeletal lesions having the appearance of fractures—regardless of history for injury or the presence or absence of intracranial bleeding—are due to undesirable vectors of force."

Seven roentgenograms; 1 chart.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Dysplasia Epiphysialis Multiplex. A Report of Fourteen Cases in Three Families. Roy H. Maudsley. J. Bone & Joint Surg. **37-B:** 228–240, May 1955.

The underlying pathology of dysplasia epiphysialis multiplex is a failure of the epiphyses to ossify normally both in rate and extent. The condition may in some cases involve most of the joints and in others, only a few. In some, the variation from the normal is slight, while in others, the changes approach those described by Morquio and Brailsford as chondro-osteodystrophy. This variation in degree and distribution has led to the diversity of conditions collected under this title.

Fourteen cases of this anomaly occurring in three families are reported. In one family, 10 of 17 members in three generations showed the abnormality, with an obvious hereditary influence. The other two families were not so thoroughly investigated. One revealed involvement in 2 siblings and the other in a father and son. Most of the patients displayed no abnormality in infancy, occasional hip pain and stiffness in childhood, and definite disability in adult life.

Dwarfism was a common feature in the cases reported. The distribution of the lesions in the three families varied. Family 1 showed involvement, in order of frequency, of hips, ankles, shoulders, spine, and skull, while the hands, feet, knees, elbows, and wrists were unaffected. In Family 2, the order of involvement was hips, shoulders, ankles and spine. In Family 3 the disease was more widespread, including the hips, shoulders, ankles, hands, feet, and elbows.

Abnormal radiographic features were limited to the epiphyses in children and joint surfaces in adults. The hips were involved in all cases. Children showed late appearance and delayed development of epiphyseal centers but no delay in fusion. In adults the lesions varied from slight irregularity of the femoral head and acetabular roof to severe coxa plana and irregular acetabula. In patients over thirty-five years of age osteoarthritic changes occurred. One child had fragmentation of the left upper humeral epiphyseal center. In several adults there was flattening of the humeral head and some dysplasia of the glenoid. In cases with ankle involvement the lower tibial epiphyses or surfaces sloped from the lateral to the medial side. In two families the small bones of the hands and feet were shorter than normal. Some cases showed irregularity of the surfaces of vertebral bodies in the thoracic region, with some wedging of these bodies.

In spite of certain differences, including the hereditary and familial nature of all of the cases and involvement of the spine in some instances, the author believes this series should be included in the condition described by Fairbank (Brit. J. Surg. **34:** 225, 1947) as dysplasia epiphysialis multiplex.

Thirty-two roentgenograms; 2 diagrams; 11 photographs.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

Dyschondroplasia and Hemangiomata (Maffucci's Syndrome). William Bennett Bean. Arch. Int. Med. **95:** 767–778, June 1955.

Maffucci's syndrome is an inborn dysplastic mesodermal anomaly in which dyschondroplasia and vascular hemangioma (angioma, phlebectasia, and hamartoma) occur together. The author presents 3 cases and reviews 7 additional cases published since 1942.

The disease may be suspected very early in life when unusual hemangiomata of the skin fail to regress or disappear. In childhood, the dyschondroplastic disorders may cause various deformities and pathological fractures. As in any dysplastic anomaly, mild examples may be overlooked until a classic form is familiar. The appearance of 3 cases in one hospital suggests that the disease is not so rare as the small number of cases reported would suggest.

The several kinds of malignant tumors to which different victims of Maffucci's syndrome have succumbed —chondrosarcoma (4), angiosarcoma (1), malignant lymphangioma (1), glioma (1), and ovarian teratoma (1)—demonstrates the high risk of neoplastic change.

This disorder has been reported in widely separated geographic regions, in Negroes and in those of Anglo-Saxon, Polish, and Italian stock.

Eight roentgenograms; 14 photographs.

THEODORE E. KEATS, M.D.
University of California, S. F.

Paget's Disease (Osteitis Deformans) Followed Twenty-One Years. Report of a Case. Edward F. Hartung. Arch. Int. Med. **95**: 869–872, June 1955.

A case of osteitis deformans (Paget's disease) with continuous observation over a period of twenty-one years is presented. The condition showed gradual progression in spite of therapy, which included a high-calcium, high-protein, low-fat diet and administration of vitamin D, estrogens, and androgens. These measures were directed toward promotion of calcium intake, absorption, and bone formation. Alkaline phosphatase studies done periodically over the period of observation exhibited considerable variation, without any perceptible association with the clinical course. There was a steady uniform increase in head circumference through the years.

Two roentgenograms; 1 graph; 2 tables.

THEODORE E. KEATS, M.D.
University of California, S. F.

Non-Osteogenic Fibroma of Bone. A Review of the Literature with the Addition of Six Cases. James A. Devlin, Harold E. Bowman, and C. Leslie Mitchell. J. Bone & Joint Surg. **37-A**: 472–486, June 1955.

The term "non-osteogenic fibroma of bone" refers to a benign marrow-connective-tissue tumor, specifically not containing any osseous elements. During a period of three years, in the Henry Ford Hospital (Detroit, Mich.) 6 cases were diagnosed which fit this classification. Five of the patients were males. The ages ranged between six and fourteen years. The lesion affected a long tubular bone and the lower extremity in all instances. The tibia was involved in 4 cases, the femur in 1, and the fibula in 1. In 2 cases there was a fracture of the bone involving the tumor area.

The roentgenographic findings were fairly similar throughout. The lesions were all located in the ends of the shafts of the long tubular bones close to, but not reaching, the epiphyseal plate. They were eccentric and somewhat oval in outline, with the greatest diameter in line with the long axis of the bone. Loculation was a constant finding. The cortex was thinned in the involved area in 4 of the cases.

Basically, the lesions consisted of spindle-shaped connective-tissue cells showing a tendency to interlace or to form whorls. There was variation in cellularity within individual lesions. In most of the lesions giant cells were a prominent feature. In many fields there was hemorrhage, but in general the tumors did not have a profuse blood supply.

Complete curettage or subperiosteal resection of the affected area is considered to be the best method of treatment.

Twenty-two roentgenograms; 12 photomicrographs; 1 table.

HOWARD L. STEINBACH, M.D.
University of California, S. F.

Vertebral Osteophytosis. Pathologic Basis of Its Roentgenology. Edgar M. Bick. Am. J. Roentgenol. **73**: 979–983, June 1955.

The appearance, nature, and significance of vertebral body osteophytes were studied in a series of approximately 300 roentgenograms of unselected patients who presented themselves for various orthopedic complaints. The author states that development of vertebral osteophytes is a specific tissue reaction to strain occurring at the areas of insertion of vertebral and paravertebral ligaments into the apophyseal rings of the vertebral bodies. Development of osteophytes may or may not be associated with other demonstrable lesions in adjacent vertebrae, disks, or apophyseal joints. The generally accepted relationship between degenerated disks and formation of bony spurs is questioned. The significance of demonstrated osteophytes is felt to depend almost entirely on the presence or absence of associated vertebral changes, particularly those of the disks and the apophyseal joints. The term "arthritis," applied to cases showing vertebral osteophytosis, is questionable and misleading.

In some of the cases included in the author's study, dissected specimens were available for comparison with roentgenograms. Osteophytes most commonly occur in the longitudinal ligaments, next most frequently in the lateral ligaments, and least often in the posterior longitudinal ligaments. The numerical difference between the occurrence of osteophytes in the cervical, thoracic, and lumbar areas is remarkably small.

Small spurs are likely to be asymptomatic; with larger ones, pain may occur as the result of associated changes.

Six roentgenograms; 3 photomicrographs.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

The Clinical Manifestations of Spondylochondrosis (Spondylosis) of the Cervical Spine. James G. Arnold, Jr. Ann. Surg. **141**: 872–889, June 1955.

Spondylochondrosis, a well established clinical entity, is characterized pathologically by formation of bony spurs or ridges along the posterior aspects of the cervical vertebral bodies with resultant pressure on the spinal cord or adjacent nerve roots. The condition is felt to be a result of degeneration of the intervertebral disks, with protrusion and local hyperplasia of the cartilage and osteophyte formation. The disease is to be differentiated from acute herniation of the nucleus pulposus.

Compression of the spinal cord or of the nerve roots by bony overgrowth results in some instances in complex and bizarre clinical manifestations. If the osteophytes primarily involve the intervertebral foramen with resultant compromise of the nerve root, the predominant clinical feature is pain, ordinarily well localized to the neck, shoulder, or upper arm. If, on the other hand, the bony ridging compresses the spinal cord, neurological manifestations may ensue in any of the extremities. Objective signs are muscle weakness, sensory disturbance, and especially spastic paraplegia.

Routine radiographic studies will frequently indicate the presence of spondylochondrosis by demonstration of the bony spurs and ridges, with narrowing of the disk spaces. The most satisfactory diagnostic procedure is cervical myelography, which will show the protrusions as filling defects in the oil column.

The author reports 10 cases of cervical spondylochondrosis. In 7 there was involvement of the long tracts of the spinal cord with paraplegia; in 2 compression of the anterior nerve roots produced the "anterior root syndrome." In the remaining case both the long tracts

and the anterior nerve roots were involved. All the patients were operated on, with performance of cervical laminectomies of varying extent. The reported results indicate some improvement in some patients but the overall benefits are rather dubious. It is emphasized that laminectomy, including section of the dentate ligaments near the points of ridge protrusion, is an important feature of the treatment. Foraminotomy was performed in cases of nerve root compromise by osteophytes. Attempted surgical removal of the offending bony bridge is hazardous.

[This report would appear to recommend rather radical treatment for an extremely common disease process in which clinical findings are frequently minor. —J. W. B.].

Twelve roentgenograms; 3 anatomical drawings, 8 photographs; 4 photomicrographs; 1 chart.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Arthrography of the Elbow-Joint. H. Arvidsson and O. Johansson. Acta radiol. **43**: 445–452, June 1955.

Elbow joint arthrography with a contrast medium was performed by the authors without complication in 97 cases. Normal joints, elbow injuries, and cases of osteochondritis and epicondylitis were included in the study. The principal positive value of such examinations lies in demonstration of capsule ruptures and collateral ligament injuries.

Lateral dislocations of the elbow seem usually to tear the medial ligament. Posterior dislocations rupture the capsule anteriorly. Coronoid process fractures suggest possible anterior tear. In children radial dislocation is often combined with avulsion of the medial epicondylar epiphyses.

In inflammatory conditions about the elbow arthrography appears to be without value.

Fourteen roentgenograms; 3 drawings; 1 table.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Bilateral Synostosis Between the Os Multangulum Minus and the Os Capitatum. A. Neiss. Fortschr. a. d. Geb. d. Röntgenstrahlen **82**: 825, June 1955. (In German)

A case is briefly presented in which, by the use of multiple views and planigraphy with the central beam directed to the expected line of cleavage, synostosis between the os multangulum minus and the os capitatum was demonstrated in both hands. The planigram sections were taken 2.5 mm. apart.

This is a rare congenital anomaly, only 14 cases having been found in the literature.

Four roentgenograms.

ALEXANDER R. MARGULIS, M.D.
University of Minnesota

The Os Trigonum. A. McDougall. J. Bone & Joint Surg. **37-B**: 257–265, May 1955.

The posterior aspect of the talus in the adult consists of two tubercles between which lies the groove for the tendon of the flexor hallucis longus muscle. The lateral tubercle is usually larger than the medial one and is often referred to as the posterior process. The tubercles vary considerably in size from small processes that are hardly visible to prominent posterior projections.

In early childhood, the posterior border of the talus is rounded with no posterior projection. Secondary centers of ossification for the processes appear posteriorly at between eight and eleven years of age. They usually unite with the main bone within a year of the time of appearance. The centers are so variable in size, time of appearance, and time of union, that they are easily overlooked in radiographs. One or two centers may be seen.

Separate post-talar ossicles are found in some adult ankles. These may be produced by repeated minor injury. When the ankle joint is fully plantar-flexed, the posterior aspect of the talus strikes the posterior margin of the tibia and limits the range of motion. Repeated impingement of a large tubercle against the tibia and compression there by the calcaneus may lead to production of a groove and eventually to separation of the tubercle from the body of the talus. Because this is a gradual process, the symptoms are minimal. Several cases are presented, with films to illustrate the stages in the process of separation.

Post-talar ossicles may also be produced by sudden injury by full forceful plantar flexion at the ankle. A case is reported of such a fracture with non-union of the fragment, producing an ossicle having the appearance of the so-called os trigonum.

A secondary center at the posterior aspect of the talus may occasionally be prevented from uniting and result in a separate ossicle.

From this study, the writer believes that secondary centers of ossification for the posterior part of the talus occur normally. Because of their situation and liability to injury by impingement against the articular margin of the tibia, these centers may infrequently be prevented from union. The incidence of the so-called os trigonum increases with age and it seems likely that this increase is the result of separation of the tubercle by repeated trauma. This separated process may be painful. Five cases are reported in which operative removal was necessary for relief of pain.

Twenty-two roentgenograms; 2 diagrams.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

The Open Reduction of Fractures of the Os Calcis. J. Hamilton Allan. Ann. Surg. **141**: 890–900, June 1955.

In the past, fracture of the os calcis has frequently been a seriously disabling injury. A review of the accepted methods of treatment indicates several schools of thought, varying from no treatment beyond prohibition of weight-bearing to immediate subtalar joint fusion. The author feels that treatment should be individualized as dictated by a careful determination of the type of fracture.

The following types are recognized:

1. Extra-subtaloid
   - A. Horizontally through the tuberosity
   - B. Vertically through the tuberosity
   - C. Anterior process
2. Intra-subtaloid
   - A. Posterior articular facet without displacement
   - B. Secondary compression of part of posterior articular facet
   - C. Secondary compression of entire posterior articular facet
   - D. Severely comminuted

In evaluation of these injuries the familiar lateral and axial views are supplemented by a special oblique or

"tangential view" of the posterior facet. The foot is placed in position as for lateral projection of the os calcis but the central ray is directed to a point just below the medial malleolus with an angulation of 30° toward the toes. This projection will demonstrate the surfaces of the posterior articular facet as seen edge-on and allow better evaluation of the degree and type of articular surface displacement and impaction.

The author believes that fractures not involving the joint proper may be conservatively treated and a good result ordinarily obtained. Fractures resulting in comminution or disorganization of the articular surfaces are best managed by immediate subtalar fusion, as more definitive attempts at reduction of the fragments are not likely to succeed. One of the most common os calcis fractures is that in which the lateral portion of the posterior articular facet is depressed or impacted while the remainder of the joint is not deformed. It is in these cases that open reduction of the joint is indicated.

Nine roentgenograms; 5 photographs; 10 anatomical drawings; 2 tables.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

GYNECOLOGY AND OBSTETRICS

Diagnostic Radiology in Obstetrics and Gynecology. Fred O. Coe. South. M. J. **48:** 609–611, June 1955.

The author presents a brief general summary of the diagnostic aid offered by radiology in the fields of gynecology and obstetrics. In his experience, Lipiodol and Ethiodol appear to be the safest and most effective contrast media for use in hysterosalpingography; injection should be by ordinary syringe rather than by any machine depending on manometric readings. Roentgenography of the abdomen to demonstrate pregnancy is described, and radiographic methods for visualization of the placenta are discussed.

The widest use of radiology in obstetrics is in pelvimetry. Findings based on post-natal follow-up of more than 300 cases in which cephalopelvimetry had been performed are presented in part.

The author considers it clearly dangerous to adminster x-ray or radium therapy at any time during pregnancy, but knows of no ill effects on the fetus or mother in carrying out any form of diagnostic radiology; the examination most frequently performed is intravenous pyelography late in pregnancy.

Correlation of the Type of Labor with Roentgen Findings. J. Maxey Dell, Jr. South. M. J. **48:** 604–609, June 1955.

Having used the Ball method of cephalopelvimetry in 1,000 obstetrical cases, the author attempts to correlate the estimated circumference of the fetal head with the pelvic diameters which it must transverse. Obviously, the larger the head for a given pelvis, the more difficult the labor will be.

In 890 cases of this series with a true conjugate of more than 10.5 cm., only 3 difficult labors occurred, due to large fetal heads. With a true conjugate of less than 10.5 cm., the widest transverse diameter of the inlet and the size of the fetal head became more critical. Of 68 patients in whom the true conjugate measured 10.0 to 10.5 cm. and the transverse diameter was above 11.8 cm., 67 experienced no difficulty. When the transverse diameter was below 11.8 cm., however, a head circumference of 32.8 cm. or more caused trouble in 5 of 7 cases; in 16 cases with head sizes below 32.0 cm., difficulty occurred in only 1.

When the true conjugate was below 10.0 cm., delivery was difficult unless the transverse diameter was ample or the fetal head small. With the conjugate between 9.0 and 9.5 cm., section was required except in 3 cases with small heads. Of patients in which the measurement was between 8 and 9 cm., 4 had sections and 2 had extremely difficult labor, with fetal head circumferences of 30 cm. and 32 cm.

The pelvic outlet was studied in the same way. Since the plane of the pelvis at the ischial spine level is considered the last bony obstruction, the author speaks of this level as the outlet, although it might properly be called the mid-plane of the pelvis. Three measurements were made at this level; (*a*) the bi-ischial (interspinous); (*b*) the hind-pelvis (posterior sagittal diameter), which is the distance from the mid-point of the bi-ischial diameter to the nearest point of the sacrum or coccyx if the sacrococcygeal joint is fixed; (*c*) the anteroposterior diameter of the outlet, measured from the inferior surface of the symphysis pubis to the lowermost fixed segment of the sacrum or coccyx.

There were 773 cases with bi-ischial (interspinous) diameters over 10.0 cm., and in this group only 3 deliveries were difficult. With lower measurements, the figures for the hind-pelvis, fetal head, and anteroposterior diameter of the pelvis become increasingly important. In 169 cases with a bi-ischial diameter of 9.5 to 10 cm. and a hind-pelvis greater than 3.6 cm. there was only one difficulty, due to a posterior position, but with hind-pelves 3.6 cm. or below and head sizes above 31.5 cm. only 6 of 24 patients had normal deliveries. In these 6 there was a compensated increase in the anteroposterior diameter to at least 11.0 cm.

With bi-ischial diameters of 9.0–9.5 cm. (57 cases) no difficulty was experienced if the hind-pelvis was above 3.6 cm. and the head circumference below 32.5 cm. If the head was larger, difficulty was encountered unless the hind-pelvis was greater than 4.2 cm.

Of 11 women with bi-ischial diameters of 8 to 9 cm., 9 had elective sections and 2 had normal deliveries, with very small fetal heads, 29 and 29.5 cm.

While pelvic measurements are quite accurate, there is need for more accuracy in measurements of the fetal head. The random obliquity with which the head is projected in the traditional right-angle views may lead to differences of 2.0 cm. for the mean circumference. If used consistently, however, the author believes that whatever method is employed will prove useful. In a very large group the radiologist may safely say that there will be no difficulty from disproportion between the head and bony pelvis. In a smaller group he can say fairly certainly that serious difficulty will probably be encountered. In the questionable group, it would be unwise to prognosticate, since the factors of age, strength of musculature, type of pelvis, and interval between examination and delivery, must all be evaluated.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

THE GENITOURINARY SYSTEM

A Comparative Trial of Urografin and Diaginol: Two Media for Intravenous Pyelography. P. A. W. Lea. Brit. J. Urol. **27:** 179–183, June 1955.

A comparative trial of two urographic media, Urografin and Diaginol (Urokon), is reported. The two

agents are somewhat closely related chemically and differ from other pyelographic media in that they are both tri-iodo compounds. Diaginol (molecular weight, 578.9) is the sodium salt of 3-acetylamino-2:4:6-tri-iodobenzoic acid. It comes in 30, 50, and 70 per cent solution. In the present investigation the 50 per cent solution was used, 20 ml. of which contain 6.58 gm. (32.9 per cent) of iodine. The solution is non-viscous. Urografin (molecular weight, 613.8) is a mixture of the sodium and methylglucamine salts of 3,5-diacetylamino-2:4:6-tri-iodobenzoic acid. It comes in a 75 per cent solution, 20 ml. of which contain 7.4 gm. (37 per cent) of iodine. The solution is viscous.

Sixty-five pyelograms in which Urografin was employed were compared with an equal number in which Diaginol was used. The studies were performed on 123 unselected patients (7 examined twice) between the ages of nine and seventy-eight, referred for intravenous pyelography.

All patients were subjected to fluid restriction prior to the examination and had been mildly purged. Ureteric compression was applied routinely after the first film at five minutes, subsequent films being taken at ten, fifteen, twenty, and twenty-five minutes. Both media were warmed to body temperature before injection. The adult dose of each was 20 ml.; 3 children under ten received 10 ml. For 12 of the patients receiving Diaginol, the injection time was three minutes but in the remaining 53 this was shortened to one to one and a half minutes. For the first 22 patients receiving Urografin the injection time was one to one and a half minutes but, after two severe reactions occurred, this was increased to three minutes.

Both media gave a very high percentage of satisfactory pyelograms in patients with normal renal function. Urografin, however, gave a higher percentage (15 per cent as opposed to 3 per cent) in which the contrast was brilliant. When injected slowly, Urografin was remarkably free from side-effects; the injection rate should not exceed 20 ml. in three minutes, whereas 50 per cent Diaginol can be injected twice as rapidly without giving rise to serious reactions. Urografin injected over three minutes produced mild reactions in 7 per cent of the patients and pain in the arm in 21 per cent. Diaginol injected over a similar period produced pain in the arm in 50 per cent of the patients but no other reactions; shortening the injection time to one and a half minutes increased the incidence of reactions to 26 per cent but decreased the incidence of arm pain to 16 per cent.

The author concludes that the differences between the two media are not striking.

Three tables.

Ureteropelvic Obstruction in Infants and Children. Clinical, Radiological and Experimental Studies on Eleven Patients. Orvar Swenson and Douglas Marchant. J. Urol. **73**: 945–950, June 1955.

The authors report a series of 11 cases of ureteropelvic obstruction in children from nine weeks to twelve years of age. Nine were males. Four were without symptoms and in only 3 were there significant urinary findings. The diagnosis of ureteropelvic obstruction was evident from the pyelograms.

The specific operative technic is described in detail. Between the third and eleventh postoperative day, the nephrostomy tube was clamped, and eight hours later intrapelvic pressure determinations were made. If the pressure was below 20 cm. of water, the tube was removed. The authors believe that this is a more physiological method of analyzing the function of the anastomosis than direct pyelography.

In general, the postoperative pyelogram revealed improvement of a continuing nature.

Two roentgenograms; 2 tables.

LAWRENCE A. DAVIS, M.D.
University of Louisville

Scrotal Calcification Due to Meconium Peritonitis. John W. Fries and Blake S. Talbot. J. Urol. **73**: 1059–1068, June 1955.

The purpose of this paper is to demonstrate that meconium peritonitis may involve the urogenital system as well as the peritoneal cavity and bowel. After a general discussion of meconium peritonitis and meconium ileus, a case of scrotal calcification is reported which is believed to have been due to escape of meconium into the abdominal cavity sometime after the fourth fetal month, followed by healing of the perforated intestine. The sterile peritoneal reaction that ensued (meconium peritonitis) resulted in deposition of calcium within the meconium. As the testis descended to the scrotum, the adjacent peritoneum containing calcific plaques followed. The calcified meconium was then distributed along the inguinal canal and the tunica vaginalis. Other areas of calcification were noted throughout the abdomen, especially on the surfaces of the liver and spleen.

Two observations are added to Neuhauser's original findings: (1) Calcific deposits over the margins of the liver and spleen and in the abdomen in an asymptomatic infant can be due to meconium peritonitis. (2) Calcification within the scrotum associated with multiple areas of abdominal calcification must be considered as resulting from meconium peritonitis.

One roentgenogram; 1 photomicrograph; 1 photograph; 2 drawings.

JOHN F. BERRY, M.D.
University of Louisville

THE ADRENALS

Value and Limitation of Roentgenographic Diagnosis of Adrenal Disease. E. F. Poutasse. J. Urol. **78**: 891–900, June 1955.

Satisfactory roentgenograms of the adrenals are difficult to obtain. The glands are closely adherent to the kidneys, and their density is approximately that of the surrounding retroperitoneal fat. The author describes the methods of roentgen visualization of the adrenals employed at the Cleveland Clinic and presents observations on their value and limitations.

For each patient with suspected adrenal disease a scout film and excretory pyelogram are obtained. If no renal displacement or soft-tissue mass is visualized, presacral oxygen insufflation, translumbar aortography, or laminagraphy is performed.

Neuroblastomas of childhood are readily visualized by pyelography, since they cause renal displacement without renal deformity or functional impairment. Frequently characteristic stippled calcification is seen. Similarly, large non-functioning adrenal cortical tumors can be demonstrated.

In the differential diagnosis of these non-hormonal lesions, Wilms' tumor, renal-cell carcinoma, and primary, unattached, retroperitoneal tumors or cysts must be considered.

For the detection of pheochromocytoma, special technics are necessary. Presacral air injection and laminagraphy are helpful. The left (posterior) oblique view may be necessary, with air studies to visualize left-sided tumors, which frequently lie anterior to the renal mass. Ten per cent of these tumors occur in retroperitoneal tissue outside of the adrenal glands and another 10 per cent are multiple.

In the adrenogenital syndrome, roentgen studies are done only if there is other evidence of an adrenal tumor. In patients with Cushing's syndrome, roentgenographic examination is important. In 3 of 16 patients renal displacement was demonstrated by pyelography and in 2 of these a malignant tumor was found. In 11 patients the pyelograms were normal. Presacral air injection was not helpful.

Aortography, though mentioned by the author, apparently did not help in detecting small adrenal tumors.

Finally, endocrinologic methods of diagnosis of pheochromocytoma and certain types of adrenal cortical hyperfunction are reliable enough to justify laparotomy without radiographic visualization.

Nine roentgenograms; 6 photographs; 1 drawing.

LAWRENCE A. DAVIS, M.D.
University of Louisville

TECHNIC

High Kilovoltage in Routine Diagnostic Radiology. J. Camerman. J. belge de radiol. **38:** 273–289, 1955. (In French)

The use of high kilovoltage (120 kv) in diagnostic radiology presents several advantages. There is a lesser charge on the tube. Reduced exposure time eliminates blurring by movement. The use of a smaller focus and greater distances reduces geometric blurring. The modification of contrast favors diagnostic interpretation. This last factor is of value in the detection of polyps in the stomach and colon and the study of mediastinal detail and soft-tissue densities overlying bone. Because of increased penetration of bone, high kilovoltage is of value only in lateral views of the thoracic and lumbar spine and in lateral views of the bony pelvis.

Further advantages afforded by this technic include reduction of patient dose, increased latitude in exposure and development of film, and better penetration in obese patients.

Nine roentgenograms.

CHARLES M. NICE, JR., M.D.
University of Minnesota

RADIOTHERAPY

Cerebral Tumors in Children: A Study of the Therapeutic Possibilities. J. A. Picaza. Rev. cubana pediat. **27:** 327–350, June 1955.

A series of 80 primary intracranial neoplasms in children under the age of fifteen years has been analyzed. Twenty-nine of the lesions were histologically malignant and therefore beyond hope of cure. Seven patients in this group were definitely improved by radiotherapy, although presumably only temporarily. In 29 patients, the neoplasm, although histologically benign, was so located that complete surgical removal was impossible. In 9 of this number significant recovery was obtained, but in 6 this was for a limited time only; 3 were alive at the time of the report. Of 22 children with benign and surgically approachable lesions, 15 were completely cured. Surgery and radiotherapy appear to be the only effective therapeutic measures for cerebral tumors in children at this time.

JAMES T. CASE, M.D.
Santa Barbara, Calif.

Chemodectomas of the Glomus Jugulare (Nonchromaffin Paragangliomas), with Especial Reference to their Response to Roentgen Therapy. Henry L. Williams, Donald S. Childs, Jr., Edith M. Parkhill, and David G. Pugh. Ann. Otol., Rhin. & Laryng. **64:** 546–566, June 1955.

Glomus formations occur in several areas in or near the middle ear. Tumors arising from these structures have been called "non-chromaffin paraganglioma." The authors prefer the term "chemodectoma," originally suggested by Mulligan (Am. J. Path. **26:** 680, 1950). Chemodectomas they define as neoplasms arising from paraganglionic tissue and composed of chemoreceptor cells. The symptoms are non-specific, not unlike those of any other slow-growing tumor in or near the middle ear. Many, however, exhibit a tendency to bleed excessively on slight trauma.

Thirteen cases are reported which were diagnosed as chemodectoma of the glomus jugulare. In 2 cases biopsy proof was not obtained. No histologic evidence of malignancy was encountered. Treatment consisted of surgery and radiation therapy in 8 cases, and surgery or radiation therapy alone in the remaining 5 cases. In no instance was there clear evidence that surgery alone prevented progression of the lesion. Four cases treated by both surgery and irradiation showed definite recession of the lesion. Radiation therapy alone did not cause the lesion to regress, nor did function return in cranial nerves involved by tumor. However, advance of the tumor seems to have been arrested after irradiation. A tumor dose in the range of 1,200 to 2,400 r in one to two weeks appeared to be sufficient.

The authors conclude that there are indications that radiation therapy alone is to be preferred in most patients with chemodectoma, although too little time has elapsed for a definite conclusion.

G. W. REIMER, M.D.
Palo Alto, Calif.

Carcinoma of the Breast in the Pregnant and the Nursing Patient. Review of 1,375 Cases. Thomas Taylor White. Am. J. Obst. & Gynec. **69:** 1277–1286, June 1955.

The author was able to collect from the literature and personal communications 1,375 cases of breast carcinoma associated with pregnancy. Carcinoma of the breast is said to complicate pregnancy "about three times per 10,000 pregnancies, while pregnancy complicates breast carcinoma about three times per 100 breast carcinomas."

The gross five-year survival rate (59 per cent) and ten-year survival rate (47 per cent) of treated patients who later become pregnant are comparable to or better than the gross survival rates for cases unassociated with pregnancy. For patients treated for carcinoma of the breast coincidentally with pregnancy since 1941, the ten-year survival rate was 21.5 per cent in the absence of metastases; for patients in this group with metastases the prognosis was "5 to 20 times as poor."

The results in patients treated for the first time during the second and third trimesters were less favorable than for those treated during the first trimester or during lactation. This may be attributed to the desire of the physician or patient to postpone treatment during the latter part of pregnancy. No clear benefit from abortion can be demonstrated.

Five tables.

R. L. EGAN, M.D.
M. D. Anderson Hospital, Houston

Time-Dose Relationship in Irradiation of Recurrent Cancer of the Breast. Iso-Effect Curve and Tumor Lethal Dose. Milton Friedman and Alexander W. Pearlman. Am. J. Roentgenol. **73:** 986–998, June 1955.

The authors point out that in almost all previously reported data on tumor lethal doses of radiations, that dose has been accepted as optimum which has resulted in destruction of the tumor provided no radionecrosis followed. The result may be acceptance of a dose which is considerably in excess of that required for destruction of the neoplasm. The purpose of the currently reported study was to investigate the optimum tumor lethal dose for recurrent cancer of the breast and to express this dose in the form of an "iso-effect curve," defining the doses which will produce similar biological effects when given over different treatment times.

A series of 29 patients with recurrent subcutaneous nodules in the chest wall following radical mastectomy for cancer was utilized for the experiment. The "corroborated dose technic" was used. Each nodule in each patient was individually irradiated with roentgen rays of the same quality, with the same field size, but with different doses delivered in different overall times. It is pointed out that such a technic obviates many of the variables (field size, tumor bed, tumor size, and biological differences) which are so difficult to evaluate. Observations were made as to the rate of shrinkage of the tumor, whether or not complete regression occurred, and whether the same nodule reappeared within six months. Data derived from each patient were then plotted on time-dose relationship graphs and an "iso-effect curve" plotted freehand. An attempt was made to determine the zone of minimal lethal tumor dose as contrasted to excessive dosage without radionecrosis, on the one hand, and dosage inadequate for sterilization on the other.

Conclusions are that the tumor lethal dose for breast cancer occupies a rather broad range, and that a significant percentage of breast cancer is relatively radioresistant. After individual charts had been compiled, a summary scatter diagram was made of data from all of the patients in the series, in an attempt to ascertain an iso-effect curve for the whole series, and presumably for recurrent cancer of the breast in the chest wall as a disease entity. The scattering of results, however, was such that a mathematical equation could not be drawn. It appears that there is no clearly defined zone between excessive and inadequate tumor dosage.

When all the successful single doses in the study were assembled in a chart, it was found that the average was 2,200 r. Fractional doses were similarly evaluated and on this basis it is felt that McWhirter's recommended tumor dose of 3,750 r in twenty-one days is inadequate for tumor control in a significant percentage of cases (24 per cent in the present series). A dose of about 4,200 r in this same period was successful in 90 per cent of the cases.

It is again pointed out that studies of time-dose relationships are difficult to summarize in exact mathematical terms because of the great variations in biological systems. However, in single patients an iso-effect curve derived from multiple lesions appears useful.

Fifteen charts; 4 tables.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Late Recurrences after Irradiation of Breast Carcinoma. H. Bohlig. Strahlentherapie **96:** 576–582, April 1955. (In German)

The author has reviewed 1,250 cases of "cured" breast carcinoma treated surgically over a period of thirty years. Late recurrences (after five years) occurred in 86, or 7 per cent. In the cases in which radiation was also administered, the late recurrence rate was 12 per cent. These late relapses, local recurrences, or metastases developed after an average interval of nine years (in one case after thirty-one years).

LEWIS L. HAAS, M.D.
University of Illinois

Eosinophilic Granuloma of Femur and Lungs: A Case Report. John H. Childers, John W. Middleton, and Martin Schneider. Ann. Int. Med. **42:** 1297–1308, June 1955.

A 24-year-old white male was admitted to the hospital in 1952 with shortness of breath, cough, and weakness. A survey film made in 1950 had shown no abnormality of the chest, but a later examination, several months before admission, revealed bilateral interstitial pulmonary infiltration with areas of small nodulation in the upper lobes and diffusely distributed small rarefactions representing alveolar emphysema. There was no mediastinal or hilar lymph adenopathy, and the cardiovascular silhouette appeared normal. The diaphragm was smooth, and the costophrenic angles were acute. There was no evidence of involvement of the bony framework of the chest. These observations were interpreted as indicative of a diffuse interstitial pneumonitis with bronchiolitis and alveolar emphysema (etiology undetermined). Subsequent pre-admission films showed some progression of the pulmonary lesions.

A right exploratory thoracotomy was performed and lung tissue was removed for biopsy. The microscopic sections showed subpleural and interstitial focal collections of eosinophils and large mononuclear cells. Fibroblastic proliferation was most marked in the margins adjacent to the visceral pleura. The central portions of the lesions were composed predominantly of histiocytes. It was concluded that these features were those of eosinophilic granuloma of the lung. The blood count was normal, with 2 per cent eosinophils.

After the pathologic diagnosis was established, roentgen survey of the skeleton was performed and a lesion in the upper portion of the shaft of the right femur was discovered. Biopsy showed this also to be an eosinophilic granuloma.

Because of the known radiosensitivity of eosinophilic granuloma, and because of the progressive nature of the patient's disability and the pulmonary lesions, external roentgen therapy was instituted, a midthoracic tissue dose of 1,200 r being delivered over a period of four weeks. Approximately the same dose was given to the lesion over the femur in about six days.

Progressive resolution of the areas of pneumonitis en-

sued, as well as healing of the femoral lesion. Three years after completion of therapy physical tolerance to exercise seemed to be normal.

Six roentgenograms; 3 photomicrographs.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Report on 641 Cases of Carcinoma of the Cervix. F. Roth. Strahlentherapie **97:** 161–174, June 1955. (In German)

The author reports on 641 cases of carcinoma of the cervix, confirmed histologically by curettage, biopsy, or autopsy, at the Gynecological Clinic of the University of Bern between 1926 and 1946.

Three hundred and seven patients (47.8 per cent) were menstruating regularly when first examined; 396 (61.7 per cent) were between forty-one and sixty years old; 15 (2.3 per cent) were below thirty. The maximum incidence centered around fifty to fifty-five years. Fifty-nine per cent of the patients did not consult a physician until one year or more after the appearance of the first symptom. Grouped according to the League of Nations system, 85 of the cases (13.3 per cent) were Stage I; 100 (15.6 per cent) Stage II; 340 (53.0 per cent) Stage III; 75 (11.7 per cent) Stage IV. Forty-one cases were recurrent or had received previous treatment. Carcinoma *in situ* was not included.

Of the 641 patients, 31 were treated by a Wertheim procedure; 53 were considered beyond all but symptomatic treatment; 557 (86.9 per cent) received combined radium and roentgen therapy.

Until 1931, radium irradiation was done in a single session. Since 1932 treatment has been by a modified Paris technic, consisting of three applications at intervals of a week. The first two applications are intrauterine, a tandem with two (20 and 20 mg.) or three (10, 20, 20 mg.) platinum capsules being left in place for 2,000 mg./hr. at each treatment. For the third (vaginal) application, two 20-mg. capsules are maintained in the fornices by corks and a spring; if the space permits, a 10-mg. capsule is placed over the portio. The total dose amounts to 6,500 mg./hr. The roentgen technic has varied over the period covered.

Five years after completion of therapy, 437 (68.2 per cent) of the patients were dead or could not be traced; 7 revealed evidence of recurrence, and 197 (30.7 per cent) were considered "absolute" cures. The absolute cure rate for 1926–31, with single-stage radium therapy, was only 18.4 per cent. With the introduction of the fractionated (Paris) technic the figure rose to 30.8 per cent. It was further improved by the installation of a constant-potential roentgen apparatus in 1937 and again by supplementary antibiotic therapy after 1942. The five-year rate for 1942–46 was 40.2 per cent.

The author does not believe that estrogenic factors can cause the appearance of carcinoma of either the cervix or breast. Of the premenopausal patients, 36 per cent survived five years as opposed to 16 per cent of those past the menopause at the time of the first visit.

Recurrences after apparently successful treatment (disappearance of induration and other signs of tumor) were observed in 83 cases (12.9 per cent). Vesicovaginal or rectovaginal fistulas developed in 15 (32. per cent) patients. Only 3 of these, appearing within six months of treatment, are considered by the author to be due to irradiation.

The term carcinoma of the cervical stump is reserved for cases discovered one year or more after a supravaginal hysterectomy. The four-year survival rate for 18 cases was 27.8 per cent.

Three diagrams; 4 tables.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

The Results of Radium Treatment of Cancer of the Uterine Cervix with Special Reference to Glandular and Stump Cancers. R. G. Maliphant. J. Obst. & Gynaec. Brit. Emp. **62:** 367–371, June 1955.

The author presents a statistical study of 1,094 cases of carcinoma of the cervix receiving radium therapy between 1930 and 1948, by a modified Stockholm technic. No supplementary x-ray irradiation or surgery was employed.

The absolute five-year survival rate on the basis of 1,116 patients seen (22 untreated because of advanced disease) was 28 per cent (61 per cent for 80 Stage I cases; 40 per cent for 419 Stage II cases; 18 per cent for 513 Stage III cases; 4.8 per cent for 82 Stage IV cases).

The series included 82 cases (5 per cent) of adenocarcinoma of the cervix, of which 58 were treated. The response to radium therapy was poor, with an overall five-year survival rate of 19 per cent (11 out of 58) as compared to 29 per cent for the epithelioma group (303 out of 1,036).

Of 23 cases of cervical stump epithelioma, 21 were treated and 7 patients survived five years or more.

Eight tables.

ALBERT R. BENNETT, M.D.
Mt. Sinai Hospital, Cleveland

Corpus Carcinoma at the Gynecology Clinic of the University of Erlangen. Report on 1,085 Cases from the Years 1886–1953, with Collected Statistics from German Clinics. Fritz Koch. Strahlentherapie **96:** 538–556, April 1955. (In German)

Between 1886 and 1953, 1,085 cases of corpus carcinoma were seen in the Gynecological Clinic of the University of Erlangen. Of this number, 58.2 per cent were operable. Six hundred and five patients were treated by irradiation and followed for five years; 278 (46 per cent) were cured. This corresponds well with the collective five-year cure rate for a number of the larger German Clinics, 45.5 per cent of 8,375 cases. The prognosis was found to be better in the younger patients. In 27 cases (2.8 per cent) a second carcinoma was found, either simultaneously or subsequently, elsewhere in the body.

Inevitably the management has varied over the long period covered by the review. At present operable growths are treated by surgery, with preoperative radium therapy and postoperative roentgen irradiation. In inoperable cases radium is used, two or three treatments in as many weeks up to a dose of 7,000 to 9,000 mg.-hr., with roentgen irradiation of the parametria.

Two graphs; 14 tables.

LEWIS L. HAAS, M.D.
University of Illinois

Vascular Tumors of the Uterus: Benign Vascular Tumors. Paul Pedowitz, Laurence B. Felmus, and David M. Grayzel. Am. J. Obst. & Gynec. **69:** 1291–1308, June 1955.

Vascular Tumors of the Uterus. II. Malignant Vascular Tumors. Paul Pedowitz, Laurence B. Felmus, and David M. Grayzel. Am. J. Obst. & Gynec. **69:** 1309–1322, June 1955.

The authors were able to collect 128 cases of benign vascular tumors of the uterus from the literature and to

these they add 10 from their own hospital records. Analyzing this series they found 62 hemangiomas, 47 angiomyomas, 26 lymphangiocystic fibromas, and 3 lymphangiomas. The neoplasms bear no relationship to parity but the incidence is highest during the fourth and fifth decades of life. Treatment is surgical removal.

The literature prior to 1920 on malignant vascular tumors of the uterus is greatly confused, and for that reason the authors reviewed only the cases since 1920. Their series, including 3 cases of their own, numbers 10, classified as hemangioendothelioma (3 cases) and hemangiopericytomas (7 cases). Although hemangioendothelioma is often malignant, hemangiopericytoma is relatively benign. The preferred treatment is total hysterectomy and bilateral salpingo-oophorectomy, followed by deep x-ray therapy.

Two photographs; 34 photomicrographs; 14 tables.

R. L. EGAN, M.D.
M. D. Anderson Hospital, Houston

Progress in the Irradiation Therapy of Uterine Bleeding. H. A. Künkel, H.-J. Schmermund, and R. Struckmann. Strahlentherapie **97:** 194–201, June 1955. (In German)

Hormonal treatment is often successful in the control of metrorrhagia in younger individuals; after the climacterium, hysterectomy or permanent destruction of the endometrium may be recommended. The latter object can be accomplished by local application of a beta emitter. Radiophosphorus was originally used by the authors for this purpose but has been replaced by radiostrontium (Sr^{90}) with its daughter yttrium (Y^{90}). The solution of P^{32} was introduced in a rubber container adapted to the uterine cavity. The Sr^{90} is used in the form of "pearls" prepared from rubber containing radioactive strontium sulfate in homogeneous distribution. The pearls, 6 mm. in diameter, with a central lumen of 1 mm., are threaded on a string and introduced into a container of low atomic weight (rubber) adapted to the size of the uterine cavity. Being very thin (15 mg./cm.^{2}), the container wall does not absorb an appreciable amount of radiation.

Histologic evaluation was performed on a patient scheduled for hysterectomy. During the second half of her menstrual cycle, fifteen Sr^{90} pearls were placed in the uterine cavity for ten hours, corresponding to a total surface dose of 180,000 r. Sixteen days later the uterus was removed surgically. Definite alterations of the endometrium were seen microscopically, extending to about 1 cm. from the internal os. Under the microscope, these changes were found to affect the entire thickness, including the basal membrane. Sections of the wall revealed a relatively well demarcated zone of karyolysis, with dilated, blood-laden capillaries at the border between muscularis and mucosa. Glandular structures could no longer be demonstrated, not even in deep layers. Such a high-grade radiation reaction is understandable with a dose of about 20,000 rep at 4 mm. or 11,000 at 5 mm. and should suffice to cause irreversible destruction of the endometrium.

Clinical evaluation of this procedure is in progress. It is suggested that the method could possibly be used also for intractable premenopausal bleeding, since regeneration of damaged endometrium occurs more often before than after forty years of age.

One roentgenogram; 1 photomicrograph; 1 graph; 2 photographs.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Lymphosarcoma of the Testis. Dean C. Varney. J. Urol. **73:** 1081–1088, June 1955.

After a review of the pertinent literature, 5 cases of lymphosarcoma of the testis are presented, and certain diagnostic and therapeutic considerations in the management of the disease are discussed. Concomitant existence or subsequent appearance of cutaneous lesions, especially with bilateral testicular involvement, favors the diagnosis.

While lymphosarcoma of the testis is generally regarded as part of a diffuse involvement, cases have been reported in which the testis was believed to be the primary site of the disease. This was true in 2 of the author's series. In 1 of these cutaneous lesions developed subsequently, and in the other pulmonary metastases occurred.

Therapeutic response to irradiation was found to be rapid, but eventual prognosis poor. Only 1 patient survived. In that case a left orchiectomy was done for an apparently primary lesion, followed by irradiation (2,500 r skin dose). Lung nodules, which first appeared some eight months later, were also irradiated, and the patient remained well at the time of the report, about two years after removal of the testis.

One roentgenogram; 4 photomicrographs; 1 photograph.

J. H. PURCELL, M.D.
University of Louisville

Respiratory Obstruction in Acute Leukemia. V. B. Levison. Lancet **1:** 1151–1152, June 4, 1955.

Respiratory obstruction is a rare manifestation of acute leukemia, though in chronic lymphatic leukemia it is relatively common. The author reports 2 cases of acute leukemia presenting as respiratory obstruction. In these cases an infiltrating lymphosarcoma was associated with a leukemic blood picture, constituting what may be termed leukosarcoma.

While it is generally accepted that irradiation is contraindicated in acute leukemia, in leukosarcoma with acute respiratory symptoms it seems to be of considerable value and may relieve the obstruction, making tracheotomy unnecessary in cases involving the larynx. Treatment must be given, however, with the greatest caution. In the 2 cases reported small doses of x-rays produced complete and permanent relief of the obstruction. In 1 patient 300 r was given over the mediastinum in eight treatments over nine days, and in the other 200 r to the superior mediastinum and trachea in three treatments over five days.

The author emphasizes the importance of distinguishing between unifocal lymphosarcoma and leukosarcoma.

Three roentgenograms.

Antroduodenectomy and X-Ray Irradiation in the Treatment of Duodenal Ulcer. A Progress Report. Grayton Brown and Ian J. Wood. Australian & New Zealand J. Surg. **24:** 260–267, May 1955.

This study concerns 81 patients who were treated for duodenal ulcer by antroduodenectomy; in 44 of these, postoperative x-ray therapy was given to the remaining stomach. A gastroduodenal anastomosis restored the normal continuity of the alimentary tract. Irradiation was administered beginning two months after the operation (see Scott, Holman, and Finckh. J. Fac. Radiologists **5:** 42, 1953. Abst. in Radiology **62:** 776, 1954) and extending over a period of three weeks. Forty-one patients received a total dose of

2,000 r; 3 patients received 1,500 r. Thirty-five unirradiated cases served as a control group.

Serial histamine test meals indicated a considerable reduction of acid secretion in the irradiated patients. After approximately three months, however, the acid level rose, often reaching normal levels. The average time of follow-up was eighteen months for the irradiated group and twelve months for the controls.

While the clinical results do not favor either group to date, the authors advocate postoperative x-ray treatment for duodenal ulcer patients undergoing antroduodenectomy. They found the clinical results of the operation to be considerably better than those obtained with a Polya subtotal gastrectomy and an antecolic Balfour anastomosis as performed in 95 consecutive patients.

Four figures; 1 table. D. D. ROSENFELD, M.D.
Oakland, Calif.

The Problem of Evaluation of Cancer Therapy. A Plea for the Use of Controls. Frank Batley. J. Canad. A. Radiologists **6:** 25–28, June 1955.

In the treatment of malignant disease the element of selection plays so large a role that extreme caution is necessary in making deductions from the results. Some examples of unwarranted conclusions are cited. One of these concerns the effect of biopsy on the prognosis of carcinoma of the breast. A table was published by Haagensen and Stout (Ann. Surg. **116:** 801, 1942) showing a 28 per cent five-year survival for mastectomies without biopsy and a 50 per cent survival when biopsy preceded the operation. This would, on the surface, suggest a favorable effect of biopsy. Actually, obvious cancers not requiring biopsy prior to surgery are more advanced than the doubtful lesions in which diagnosis must be established by that means. One group is therefore loaded with far advanced cases, which would account for the relatively poor results, and a fruitful comparison is impossible.

Since the composition of series of patients with the same disease will vary from clinic to clinic and even in the same clinic over periods of time, the published results of treatment have so many variables that they are of little value as comparisons of methods of treatment. A special effort must be made to obtain controlled series either by random division of cases or matching of cases.

Three tables; 1 graph. FRANK T. MORAN, M.D.
Auburn, N. Y.

Influence of the Electromagnetic Field upon the Action of the Electron in the Treatment of Cancer. Pedro L. Fariñas and Pedro O. Martinez Fariñas. Am. J. Roentgenol. **73:** 999–1005, June 1955.

The authors describe a unique experimental approach to therapy of advanced neoplasms. Briefly, it consists in using Compton effect electrons produced by irradiating with x-rays a heavy metal (iron) just above the patient. Immediately below the iron, on the patient, is a copper cathode, while below the patient is a smaller plate of copper forming the anode. These are connected to a direct-current constant electromagnet which produces electric and magnetic fields. The anode is made smaller than the cathode to produce a convergent field of electrons through the tumor region. The electrons which pass through the patient and tumor have an increased kinetic energy because of the presence of an electric field. Previous experimental work by others has shown evidence of biological effects of magnetic fields, but the present authors are the first to consider the possibility of their use for making neoplastic tissue radiosensitive.

Forty-four patients with advanced neoplasm were exposed to the above type of treatment using various technical factors. Early relief of pain—within forty-eight hours after the first treatment in some instances—was especially noteworthy. Complete disappearance of the tumor, with total remission of symptoms, occurred in 20 per cent of the cases. Complete symptomatic relief but without total tumor disappearance was noted in 48 per cent, while only 32 per cent showed little or no benefit.

[The above work was done in 1951. The senior author died in April of that year and the results as published are admittedly incomplete. A follow-up report at this time on the early favorable cases would be of considerable interest. J. A. G.].

Four roentgenograms; 1 drawing; 3 tables.
J. A. GUNN, M.D.
Grand Rapids, Mich.

Ionization Chambers for the Dosimetry of Beta-Ray Applicators. J. L. Haybittle. Brit. J. Radiol. **28:** 320–324, June 1955.

Measurements of doses from beta ray applicators in the past have been made with either shallow disk-shaped ionization chambers or with extrapolation chambers. In this article the author shows that there are several sources of possible error with the disk-shaped chamber. On the other hand, use of a chamber of fixed depth with an air space considerably larger in diameter than its collecting electrode gives results in agreement with those of an extrapolation chamber. In addition, such a chamber is relatively easy to construct and requires fewer experimental readings in use than does the extrapolation chamber.

Five diagrams; 5 plotted curves; 1 table.
DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

A Method for Three-Dimensional Dose-Finding in Teleradium Therapy. Rune Walstam. Acta radiol. **43:** 477–486, June 1955.

A wire jig device for dose finding and beam direction has been designed and used at Radiumhemmet in treatment of oral cavity carcinomas. Its construction and application are presented here in detail.

The jig is essentially a simple soft wire triangle or quadrangle laid upon the skin. Each corner serves as the center of a treatment portal, the site of which is selected in accordance with clinical indications. Small guide wires affixed at the corners of the jig permit reproduction of the port angles from treatment to treatment. By placing isodose diagrams over each of these corner guide wires, it is possible to calculate the dosage at various points within the treatment area.

The method is applicable only when there is circular symmetry in the dose distribution of the teleradium apparatus, and only when treatment is given through three or more fields which do not all lie in the same plane.

A great advantage lies in the fact that the wire jig permits reconstruction of a given treatment at any time after initial irradiation.

Seven photographs; 2 tables; 1 diagram.
DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Intercomparison of Fast-Neutron Dosimeters. H. H. Rossi, G. S. Hurst, W. A. Mills, and H. E. Hungerford, Jr. Nucleonics **13:** 46–47, April 1955.

A comparison is made of two different types of fast-neutron dosimeters: (1) the proportional counter chamber which, together with its associated electronic apparatus, is sensitive only to neutrons, and (2) a tissue-equivalent ionization chamber sensitive to both neutrons and gamma rays. The readings of the latter chamber were partially corrected by measuring the ionization observed in a graphite chamber primarily sensitive to gamma radiation and with a small neutron response. This intercomparison is of interest since these are the only two instruments presently used for the determination of fast neutron dose. A Van de Graaff generator and a Cockroft-Walton accelerator were employed with deuterium, tritium, and lithium targets to obtain neutrons with energies at various levels between 0.1 and 15 Mev. Additional measurements were also made with a polonium-beryllium source and a polonium-boron source. Details of the geometry and comparison procedures are given. The general conclusion is that the response of the neutron proportional counter dosimeter was lower than that of the tissue-equivalent ionization chamber by an amount somewhere between 5 and 15 per cent.

Two tables.

JOHN S. LAUGHLIN, Ph.D.
Memorial Center, N. Y.

RADIOISOTOPES

Radioisotope Production Rates in a 22-Mev Cyclotron. John A. Martin, Robert S. Livingston, Raymond L. Murray, and Mozelle Rankin. Nucleonics **13:** 28–32, March 1955.

This article attacks the belief that production of isotopes by accelerators is inordinately expensive. A brief historical description is given of the initial use of cyclotrons and the later use of neutron reactors for the production of widely used radioisotopes. It is emphasized that the cyclotron largely complements the nuclear reactor, since cyclotron-produced isotopes are usually neutron-deficient and decay principally either by electron capture or positron emission. An advantage associated with most cyclotron-produced radioisotopes is their high specific activity; since they are of a different chemical element than the target, they can be separated relatively carrier-free.

A description is given of the Oak Ridge National Laboratory 86-inch cyclotron, together with technical details of the removal and construction of the target. The cyclotron is used with protons and can reach an energy of 26 Mev, although 22 Mev was chosen for tabulated estimates of yields of various reactions. A comprehensive table is presented, listing all target isotopes of at least 10 per cent natural abundance, with radioactive products having half-lives greater than one hundred minutes. Only p,n and $p,2n$ reactions are included as most important. The table lists the product isotope, its half-life, the target isotope, its natural abundance, and the yield in atoms, and also in millicuries per ma-hr. of proton bombardment. The estimated yields are obtained primarily on the basis of theoretical calculation, though some rest on experimental data. The procedures for the calculation and assumptions involved are described.

Two photographs; 1 graph; 2 tables.

JOHN S. LAUGHLIN, Ph.D.
Memorial Center, N. Y.

Thyroid Carcinoma: A Report on the Diagnostic and Therapeutic Use of Radio-Iodine. S. Kramer, J. P. Concannon, H. D. Evans, and G. M. Clark. Brit. J. Radiol. **28:** 307–313, June 1955.

Forty-eight patients with thyroid carcinoma have been investigated or treated with I^{131} at the Royal Cancer Hospital in London since 1949. Diagnostic studies were done in all, including scintigraphic scanning of the entire body in some instances as well as uptake studies locally over the thyroid area.

Thirteen patients showed iodine uptake by the tumor considered adequate to warrant radioiodine therapy. Twelve were treated by the isotope and 6 of these showed improvement and regression of the tumor mass. One patient with an advanced, well differentiated colloid-secreting carcinoma with pulmonary metastases was well after five years, with no evidence of residual tumor.

There were 9 patients with metastases, and in all but 2 of these the metastatic deposits showed uptake of the tracer dose. In 2 cases the iodine uptake gave the first indication that remote disease was present.

There is no constant relationship between the histologic type of the tumor and iodine uptake, although the well differentiated adenocarcinomas are more likely to concentrate iodine.

In patients showing no iodine uptake on initial tracer studies, this was not increased by thyroid ablation. In 2 patients, thiouracil apparently enhanced the initial uptake of iodine by metastases.

Two roentgenograms; 3 photographs; 3 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Radioactive Phosphorus in the Diagnosis of Skin Tumors. Differentiation of Nevi, Malignant Melanomas, and Other Skin Tumors. Franz K. Bauer and Charles G. Steffen. J.A.M.A. **158:** 563–565, June 18, 1955.

Cells with increased metabolic activity require more phosphorus than similar cells with normal metabolism. This fact has been utilized to localize malignant lesions, both primary and metastatic, by external counting of concentrations of radioactive phosphorus (P^{32}) used as a tracer. The authors attempted to develop a procedure whereby benign nevi could be differentiated from malignant melanomas even before biopsy, since the extent of the biopsy could be influenced by such knowledge. They felt that evidence of increased radiophosphorus concentrations might also be of help in equivocal histopathological interpretations, which are so common in the so-called juvenile melanomas and junction nevi.

Radioactive phosphorus is injected intravenously in doses of from 100 to 150 microcuries. One to three hours later, a count is made with an end-window Geiger-Müller tube. Five hundred counts are taken over the lesion and the same number over the contralateral normal area. The number of counts obtained over

normal skin is of the order of three to ten counts per second.

Of the 70 patients studied, there were 6 with proved malignant melanoma, 10 with squamous-cell carcinomas, and 9 with basal-cell carcinomas. The remainder had intradermal or junction nevi, seborrheic keratoses, verrucae, and granulation tissue. Counts obtained over nevi, seborrheic keratoses, verrucae, and benign tumors showed no variation from normal, and no patient with increased concentration was found to have a benign lesion. Granulation tissue, such as occurs after burns or biopsies, gave higher counts than corresponding normal skin, presumably due to extravasation of P^{32}-containing serum and the increased P^{32} content of granulating tissue. Whenever more than a few millimeters of tissue was interposed between the lesion and the tube, the ratio between the tumor and normal area decreased. Thus, it is apparent that only in superficial lesions can significant differences in counts be obtained.

Although both phosphorus and potassium are universal cell constituents and may be used as tracer agents, P^{32} is a more convenient material, since its half-life is 14.3 days and it is a beta emitter. K^{42}, on the other hand, has a physical half-life of only 12.4 hours and emits gamma rays, which make it less easy to handle and more expensive to shield and ship. P^{32} has the disadvantage, however, that its most energetic beta particles penetrate only about 7 mm. in tissue.

It should be pointed out that increased concentration of P^{32} in tissue does not necessarily mean a malignant process. Increased metabolic activity is also present in infections and granulating wounds. The increase in phosphorus, therefore, is merely an indication of increased growth and, if present, should make the clinician "malignancy conscious." The authors' findings agree with those of others that the concentrations of P^{32} in malignant skin tumors are far too low for systemic therapy.

It is concluded that malignant melanomas can be differentiated from benign nevi by significantly increased concentrations of P^{32}. Basal-cell carcinomas and squamous-cell carcinomas, because of their slow growth rate, cannot be differentiated from benign lesions.

Two tables. JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Treatment of Inoperable Prostatic Carcinoma by Au_{198}. Louis M. Orr, James L. Campbell, and Miles W. Thomley. J. Urol. **73:** 1089–1095, June 1955.

The authors present their results in 26 consecutive cases of advanced carcinoma of the prostate treated by instillation of Au^{198}. The average age of the patients in the series was 68.8 years, with the youngest fifty-two and the oldest eighty-one. The weight of the average prostate, estimated preoperatively, was 32 gm. The amount of Au^{198} delivered into each gland was generally based on its size and the amount of tumor present. The average dose given per operation was 90.3 millicuries; on the basis of the average size, this is a ratio of 2.1 millicuries per gram of tissue, which is higher than the reported optimum dosage. The largest dose to any one patient was 200 millicuries; however, this was delivered in two operations, five and a half months apart. The largest dose of the isotope administered at a single operation was 145 millicuries and the smallest 25. Additional Au^{198} was injected through the perineum in 4 cases.

Delayed wound healing and prolonged suprapubic drainage of urine were the most frequent complications. All patients remained hospitalized until drainage stopped, an average of twenty-two days. It was felt that the inflammatory reaction from the irradiation had a definite effect on wound healing, which was delayed in 5 cases. Two patients had pulmonary emboli. There were 5 deaths in the entire series; 4 of these occurred among the first 6 patients treated. Results were considered excellent in 14, good in 2, fair in 3, poor in 2.

Three tables.

Blood-Drop Determination of Au^{198} in Prostate Therapy. Wayne M. Rounds and Titus C. Evans. Nucleonics **13:** 52–54, April 1955.

The authors describe a method for continuous monitoring of radioactivity in circulating blood and its application in the therapeutic use of radioactive colloidal gold. It is emphasized that the large doses used in the treatment of prostatic carcinoma necessitate knowledge of the proportion entering the circulation.

The procedure is simple, involving puncture of a single vein and the collection of the blood drops on a continuously moving tape. Drops are produced at approximately fifteen-second intervals and followed for a period of about eight minutes before clotting occurs. During this time the patient loses approximately 6 ml. of blood. Counting is done by a mica end-window tube. Calibration checks are made by withdrawing 1 to 5 ml. of blood into a well-type gamma counter. The mounting of a probe counter for measurements over the liver is also described.

The use of this blood-drop monitoring method has served to indicate the proper time for withdrawing blood for determinations and also to check on each colloidal gold injection to prevent loss from the injection site.

Two graphs; 1 drawing.

JOHN S. LAUGHLIN, Ph.D.
Memorial Center, N. Y.

Protracted Interstitial Irradiation of Tumours Using ^{182}Ta. Lionel Cohen. Brit. J. Radiol. **28:** 338–340, June 1955.

In an effort to evaluate the effect of protracting radiotherapy over long periods, the author undertook the present study. Permanent implants of tantalum 182, a relatively weak, moderately long-lived source of gamma rays, were used. The therapeutic ratio of this substance proved to be relatively large, and initial results appeared promising.

It is possible to prepare this material and to calculate doses from it rather meticulously. Implantations are made in the same manner as with radon seeds. Three-millimeter wire "grains" of 1 mc. activity per linear centimeter are used. The ionization function is 6.1 r/mc-hr. at 1 cm. as compared with 8.4 r/mg. hr. at 1 cm. for radon.

Provisionally, the indications for this type of therapy are considered to be: (1) large epitheliomas or those with extensive regional node involvement; (2) recurrences after previous irradiation; (3) relatively inaccessible or poorly tolerant areas.

Intense fibrosis has been observed to develop in implanted areas.

One roentgenogram; 1 nomogram; 2 photographs.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

RADIATION EFFECTS; EXPERIMENTAL STUDIES; PROTECTION

Radiation Reactions of the Lung and Pleura after Irradiation of Breast Carcinoma. Hans-Joachim Fiebelkorn and Horst Hillger. Strahlentherapie **96:** 583–592, April 1955. (In German)

Engelstad (see, for example, Am. J. Roentgenol. **43:** 676, 1940) found, in animal experiments, that post-irradiation lung reactions develop in four stages. The first stage, appearing in a few hours, is represented by degeneration in the lymph follicles, hyperemia, transudation, and leukocytic infiltration. It lasts for two or three days. In the second or latent stage these alterations regress. The third stage, representing the main reaction, occurs one to two months after irradiation and consists in degeneration of the bronchial epithelium, pulmonary stroma, and alveolar epithelium, with perivascular and intra-alveolar serous-cellular exudate. In the fourth stage, the stage of regeneration, macrophages remove the destroyed cellular elements. After approximately six months the process is concluded by ingrowth of fibrocytes, producing serious late damage in the form of granulation tissue, nodulation, and proliferation of bronchial and alveolar epithelium.

In human patients only the third and fourth stages can be observed. The main reaction is manifest clinically in about eight weeks, by cough and leukocytosis. The phase of regeneration may be observed from six to twelve months after irradiation. Radiologically, in the earlier stage there are strands and areas of homogenous haziness in the lung fields, with pericardial and diaphragmatic adhesions. In the later phase fibrous strands are characteristic, with small sharply delineated nodules. Pulmonary radiation necrosis has never been described in man. It was produced in animal experiments only by doses of over 10,000 r.

The authors found pulmonary or pleural reactions in 66 (15.1 per cent) of 437 patients irradiated for mammary cancer. Pleural reactions alone were present in 13.7 per cent, involving particularly the diaphragmatic pleura. Pleural effusions are usually attributable to carcinomatosis.

The damaging dose is variable. A tissue dose of 3,000 r is frequently sufficient to produce these reactions. Individual factors exert a great influence, as previous pneumonia, poor general condition, old age, condition of the vegetative nervous system, etc.

Eleven illustrations, including 7 roentgenograms.

LEWIS L. HAAS, M.D.
University of Illinois

Herpes Zoster After Roentgen-Irradiation. W. Rübe. Strahlentherapie **97:** 297–304, June 1955. (In German)

Although herpes zoster is presumably caused by a virus, certain predisposing or precipitating factors have been described. The author found 6 cases among 200 patients irradiated for carcinoma of the breast, an incidence of 3 per cent as compared to 0.025 per cent among the general population. Three additional cases (occurring after treatment for carcinoma of the cervix, Hodgkin's disease, and lichen ruber accuminatus) are also reported, with the statement that no example was observed in a large number of persons receiving superficial x-ray therapy.

The latent period between irradiation and the appearance of herpes—from a few weeks to two years—favors the explanation offered by Ellis and Stoll of England, *i.e.*, post-irradiation gliosis and vascular changes in the spinal ganglia corresponding to the affected segment(s) (Brit. M. J. **2:** 1323, 1949). This, however, is not in agreement with the fact that the complication has appeared when the involved part, but not the respective ganglia, had been irradiated. Moreover, the histologic examination in one of the author's cases revealed only the diffuse ganglionitis expected with herpes necroticans, but no evidence of fibrosis nor of hyaline or thrombotic vessel alterations. Irradiation trauma, acting directly upon the affected periphery, may still be the cause for increased incidence of herpes zoster following deep x-ray therapy.

Six photographs; 1 photomicrograph.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

The Incidence of Leukemia in Ankylosing Spondylitis Treated with X-Rays. A Preliminary Report. W. M. Court Brown and John D. Abbatt. Lancet **1:** 1283–1285, June 25, 1955.

A preliminary report is made of an investigation into the death rate from leukemia among patients with ankylosing spondylitis treated with x-rays. Data were collected on 9,364 patients thus treated from 1940 to 1954 in thirty-seven radiotherapy centers in England, Wales, and Scotland. The expected number of deaths from leukemia in this series was calculated on the male age-specific death rates from leukemia in England and Wales for 1953.

From information supplied by seventeen radiotherapy centers concerning 3,085 patients, an estimate was made of the proportion of patients who had been kept under observation since completion of x-ray treatment. Of the 3,085 patients, 1,731 (56 per cent) were reporting periodically for examination or were known to have died, while 1,354 patients (44 per cent) had been lost sight of.

Records were obtained of 25 patients in whom leukemia developed, including 4 in whom it was believed to have been present when the patients were first irradiated for spondylitis. Fifteen of the patients with leukemia had received more than one course of x-ray therapy.

The observed deaths from leukemia were found to be at least five times, and possibly as many as ten times, the expected number of such deaths; among those patients given more than one course of irradiation, the observed deaths were probably at least nine times those expected to occur.

Evidence is presented which suggests that patients with ankylosing spondylitis may be unusually susceptible to the development of leukemia. But it is also likely that the incidence of leukemia is appreciably increased among those patients given more than one course of x-ray therapy.

In spite of the above findings, the authors think it would be wrong to withhold x-ray treatment from those suffering from ankylosing spondylitis. It is common knowledge that the life expectancy of many of these patients is reduced by their disability, and most authorities agree that radiotherapy has in many instances a beneficial effect. What is certain, however, is that no one should be treated with x-rays unless the diagnosis is

clearly established, and that a second course of irradiation should not be given unless absolutely necessary.

Three tables.

Aplastic Anaemia and Myeloid Leukaemia after Irradiation of the Vertebral Column. H. van Swaay. Lancet **2**: 225–227, July 30, 1955.

Seven cases are reported from Holland in which x-ray therapy for ankylosing spondylitis was followed by a fatal blood dyscrasia (5 myeloid leukemia, 2 aplastic anemia). In all but 1 the leukemia developed within five years of the exposure. In only 1 patient was the dosage of x-rays thought to be excessive.

The author was able to find in the literature mention of 6 additional cases with hematologic complications following irradiation for spondylitis (see also preceding abstract). He believes that the occurrence of these cases suggests the need for careful consideration of the hazards before starting radiotherapy.

A Clinical Investigation of the Chronic Effects of Radium Salts Administered Therapeutically (1915–1931). W. B. Looney, R. J. Hasterlik, A. M. Brues, and E. Skirmont. Am. J. Roentgenol. **73**: 1006–1037, June 1955.

The authors have studied 19 psychotic patients hospitalized at the Elgin State Hospital (Illinois) who were injected intravenously, at weekly intervals, with a soluble radium salt in doses of 10 μg. of the element, for total doses of 70 to 450 μg., 20 individuals who were given radium as a therapeutic procedure twenty to thirty years ago, and 6 "dial painters" from a watch dial factory. The case histories are presented.

The roentgenographic changes associated with radium in the bones are classified into three groups:

Group I: The significant minimal roentgenographic lesions observed by the authors are multiple 1 to 2-mm. by 5 to 20-mm. areas of decreased density located most frequently in the fibula, tibia, radius, ulna, humerus, and femur. Related lesions are the "punched-out" areas of decreased density in the skull, which must be differentiated from multiple myeloma. When the areas of decreased density that occur in long bones become multiple, they produce a "streaked" appearance.

Group II: Areas of apparently increased density usually associated closely with areas of decreased density and showing changes in the trabecular pattern are characteristic of this group. Some changes in the bones resemble the localized bone infarcts seen in "caisson disease," and are not specific for radium poisoning. They most frequently appear in the alae of the ilium and the heads of the femur and humerus.

Group III: Repeated mechanical insult may produce areas of aseptic necrosis, often with sequestration at sites of radium deposits in bones. The lesions are observed in the mandible, tarsal scaphoid, vertebral bodies, head of the femur, and occasionally the head of the radius and superior aspect of the acetabulum.

Bone lesions could be recognized when the body burden was 0.4 μg. or higher, except in 3 individuals.

None of the bone lesions alone are diagnostic of radium poisoning but are suggestive. Radium poisoning cannot be detected by hematologic studies.

Sarcomas were seen in 4 patients who had received radium salts orally or who were radium dial painters. The oral and paint preparations may contain mesothorium and radiothorium.

In 1 patient who received only Ra^{226} intravenously an osteogenic sarcoma of the right tibia developed.

Thirty-one roentgenograms; 2 photomicrographs; 1 photograph; 2 charts; 3 tables.

J. P. CHAMPION, M.D.
Grand Rapids, Mich.

Genetic Hazards in Ovarian Radiation. Roberts Rugh. J. Obst. & Gynaec. Brit. Emp. **62**: 461–463, June 1955.

The author points out the hazards, from a genetic point of view, incident to roentgen irradiation of the ovaries in an attempt to overcome sterility. In particular he challenges the conclusions of Kaplan (J. Obst. & Gynaec. Brit. Emp. **60**: 872, 1953. Abst. in Radiology **63**: 626, 1954), who has reported several generations free from injury after ovarian irradiation for sterility.

On the basis of radiobiological research, the following points are made:

(1) X-rays, even in small doses, produce genic mutations in the reproductive cells, and such changes are irreparable.

(2) The frequency of gene mutation is proportional to the total dose of radiation, so that there is a cumulative effect.

(3) Radiation-induced mutations are inherited and will continue to exert a deleterious effect on the hereditary line.

The author suggests that any patient submitted to irradiation of the ovaries be advised of these facts and of the responsibility of contributing to the genetic delinquency of her descendants.

ALBERT R. BENNETT, M.D.
Mt. Sinai Hospital, Cleveland

A Clinical Trial of Cysteinamine (Beta-Mercaptoethylamine) in Radiation Sickness. W. M. Court Brown. Brit. J. Radiol. **28**: 325–326, June 1955.

Cysteinamine has been reported to be of aid in the protection of mice against total-body roentgen irradiation and to help in the treatment of radiation sickness. In 12 patients about to receive radiotherapy following operation, attempts were made to modify the time of appearance of symptoms of radiation sickness by administration of cysteinamine immediately before or within an hour following treatment. The drug apparently was without effect on the length of the latent period.

One plotted curve; 1 table.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Effect of X Irradiation on the Growth of the Ehrlich Ascites Tumor. László Révész. J. Nat. Cancer Inst. **15**: 1691–1701, June 1955.

In this study of the effect of radiation on the growth of Ehrlich ascites tumor cells, irradiated ascitic fluid containing 18×10^6 tumor cells was injected intraperitoneally into groups of 25 to 30 mice. The course of ascites tumor growth was then followed in the injected animals by sacrificing two daily and determining the volume of fluid and the total number of tumor and non-tumor cells by a dye-dilution method. All irradiations were carried out in a nitrogen atmosphere. Growth curves obtained after different x-ray doses were compared to those for non-irradiated tumor cells. With 1,000 r or higher, the number of cells in the ir-

radiated population was lower than the number of non-irradiated cells at all time intervals studied except during the last stage of the growth period.

To study the influence of irradiated cells on the growth of untreated cells, those exposed to lethal doses of x-rays were mixed with non-irradiated cells in two different proportions. The resulting mixtures were inoculated into mice and the growth of the cells was followed. Tumor cells damaged by 5,000 r exerted either an inhibiting or an enhancing effect upon the growth of admixed viable cells, depending on their quantitative proportion. The irradiated cells inhibited the growth of a small population of non-irradiated cells inoculated simultaneously and also prevented the development of subsequently injected ascites tumor. These findings were interpreted as being due to an immunization of the host by dead or dying cells. The irradiated cells appeared to exert an enhancing influence on the growth of a large population of non-irradiated cells. This observation suggested either that dying cells might release substances capable of stimulating tumor growth or that surviving cells which recovered from the effects of irradiation might later have contributed to the total number of growing tumor cells. The possible role of these effects in determining the growth characteristics of ascites tumor cells following irradiation of the whole population is discussed.

Quantitative studies on the ascites volume and the number of non-tumor cells in the peritoneal cavity showed that the inoculation of irradiated Ehrlich ascites cells called forth a prompt inflammatory response in the host.

Six graphs.

Effects of Fasting and X-Irradiation on Oxygen Poisoning in Mice. Daniel L. Gilbert, Rebeca Gerschman, and Wallace O. Fenn, with the assistance of Peter Dwyer. Am. J. Physiol. **181:** 272–274, May 1955.

In previous studies the authors have shown that irradiation of mice with 8,800 r increased their sensitivity to 6 atmospheres of oxygen for a period of about five hours and protected them against the oxygen after longer periods (Science **119:** 623, 1954). It was postulated that this marked protection, observed after ten or more hours, might be due to the anorexia which occurs in irradiated animals, and the experiments described in the present report were undertaken to test this hypothesis.

Four groups of mice were used: normal animals; fasted animals submitted to oxygen eighteen, thirty, forty-eight, seventy-two, and eighty-four hours after the removal of food; irradiated animals exposed to oxygen forty-eight, seventy-two, and eighty-four hours following irradiation; fasted-irradiated animals submitted to oxygen forty-eight, seventy-two, and eighty-four hours after the removal of the food and beginning of the irradiation.

It was found that fasting for eighteen hours increased the survival time of mice in 6 atmospheres of oxygen and that longer periods of fasting increased the protection still further. After eighty-four hours of fasting, the survival time was increased by 97.4 minutes, or more than 200 per cent. The irradiated and fasted-irradiated mice were protected to about the same extent as the fasted animals at corresponding intervals. It appears, therefore, that the protective effect of previous irradiation against oxygen poisoning can be attributed to the anorexia resulting from irradiation.

A further experiment to determine effects of fasting alone and irradiation alone, without oxygen, is described.

Two graphs; 2 tables.

Role of Thyroid Hormone in the Pathogenesis of Joint Disease in Mice. Effects of Radiothyroidectomy and High-Fat Diets. Martin Silberberg and Ruth Silberberg. J. Bone & Joint Surg. **37-A:** 537–548, June 1955.

In mice of various strains the structure and function of the thyroid gland vary. Thus, mice of strain Dba have comparatively active thyroids, while in mice of strain $C_{57}BL$ the gland is comparatively inactive. In $C_{57}BL$ males, a high-fat diet increased the incidence and advanced the onset of degenerative joint disease, while in Dba males the fat-enriched diet failed to exert significant effects on the articular structures. It was assumed that differences in thyroid activity might be related to the strain differences in this dietetic response. The fat-enriched ration was, therefore, fed to adult mice of both strains after their thyroid glands had been destroyed by injection of I^{131}. Following this treatment, the response of the two strains was reversed. In the absence of thyroid secretions, $C_{57}BL$ mice became less susceptible than Dba mice to the injurious effect of the high-fat diet, while Dba mice became more susceptible than Dba mice with intact thyroids.

Radiothyroidectomy also produced characteristic articular changes differing from degenerative joint disease, which were designated "athyroid joint disease." The susceptibility to this lesion likewise varied with the thyroid activity characteristic of the strain. Dba mice showed a high incidence and a severe degree of this disease, while $C_{57}BL$ mice were less frequently affected and showed only low-grade lesions. A fat-enriched diet, in turn, adversely influenced the course of athyroid joint disease in both strains.

Thus, the thyroid hormone plays a major role in the development of the growing joint and in the maintenance of the adult articular structures under normal conditions, as well as under abnormal conditions. The extent of this influence varies with the degree of thyroid function characteristic of the particular strain of mice or of the individual.

Five photomicrographs; 3 graphs; 4 tables.

HOWARD L. STEINBACH, M.D.
University of California, S. F.

A Cytologic Study of the Intestinal Epithelium of the Mouse After Total-Body X-Irradiation. William Montagna and J. Walter Wilson. J. Nat. Cancer Inst. **15:** 1703–1736, June 1955.

Though much attention has been focused on the sensitivity of the intestinal mucosa to x-irradiation, only a few papers report in detail the progress of events which culminate in maximal damage and subsequent repair. The present study is concerned with (*a*) the time sequence of the development of injury and repairs in the mucosa of the intestine, from one-half hour after exposure to death, in mice receiving lethal doses of x-rays; (*b*) the behavior of nucleic acids, mucus or other polysaccharides, periodic acid-Schiff-reactive substances and lipids during the development of the injury; (*c*) nuclear damage in the crypts of Lieberkühn, the aberrant mitotic activity during the early periods of repair, and repair in the crypts of Lieberkühn.

The first series of experiments comprised 3 groups of 12 mice each; all 36 were irradiated with 1,000 r (200 kv, 20 ma, with added filtration of 0.5 mm. Cu and 1.0 mm. Al). The dose rate at 20 cm. distance was 240 r per minute. A fourth group of 24 mice was irradiated with 550 r under the same conditions. Animals were killed at intervals of one-half hour to ninety-six hours following irradiation.

Differences in the severity of damage to the intestine were evident in the two series of animals irradiated at 1,000 r and 550 r, respectively.

Total-body x-irradiation with 1,000 r stops mitotic activity in the cells of the crypts of Lieberkühn. After one-half hour most of the nuclei are enlarged and some have undergone karyolysis. By twelve hours, nuclear swelling, karyolysis, and karyorrhexis are more advanced, cytoplasmic basophilia is conspicuously reduced, and many of the cells perish. Sparse and abnormal mitotic activity reappears at this time. After forty-eight hours the degenerative processes in the epithelium of the crypts have passed their peak, except for the Paneth cells, the nuclei of which are just beginning to be swollen; in the cells at the tips of the villi the nuclei begin to be swollen and the cytoplasm loses its basophilic staining. By seventy-two hours Paneth cells have fragmented and have been extruded into the lumen, and the partially repaired crypts contain a number of normal cells. The cells in the epithelium in the distal half of the villi are distorted, the cytoplasm is laden with lipid globules and periodic acid-Schiff-reactive globules; the nuclei are pyknotic or show karyolysis. Cells flow together and form multinucleated giant masses. By ninety-six hours many of the crypts appear to be normal, but the epithelium of the villi shows a maximal amount of damage.

The cells of the crypts, then, are extremely sensitive to x-rays, whereas those on the villi are relatively resistant. The cells of the villi become damaged forty-eight or more hours after exposure to x-rays, at a time when the cells of the crypts are being repaired. The animals die when the villi show their greatest damage, but the crypts are largely repaired. The destructive changes in the epithelium of the mucosa could, at least in part, be responsible for the death of the animals.

The goblet cells in the crypts and in the villi become progressively larger until about forty-eight hours after x-irradiation. In the crypts of the ileum and in the cecum the first metachromatic staining of the goblet cells becomes more intense until they degenerate. X-irradiation seems to hold mucigen in the goblet cells, with very little of it being secreted into the lumen of the gut. The stagnated mucigen could imbibe water and distend the cell.

In mice x-irradiated with 550 r, the progress of the injury in the epithelium of the intestine is qualitatively similar to that in mice irradiated with 1,000 r, but the damage is less severe.

Forty-two photomicrographs.

The Effect of Streptomycin Therapy on Mice Irradiated with Fast Neutrons. Carolyn W. Hammond, Howard H. Vogel, Jr., John W. Clark, Dorothy B. Cooper, and C. Phillip Miller. Radiation Res. **2**: 354–360, June 1955.

CF1 female mice were exposed to doses of fast neutrons ranging from 200 to 260 rep. Treatment consisted of a daily subcutaneous injection of 5 or 6 mg. of streptomycin in 0.5 ml. sterile saline. Therapy was begun usually on the first day post-irradiation (in one experiment on the fourth day) and continued for five to fifteen days. Control mice received daily injections of 0.5 ml. of sterile saline.

Mortality in the streptomycin-treated mice was significantly reduced during the first ten days but was not altered during the remainder of the acute phase. The reduction in mortality, when expressed as reduction in the effective dose of radiation, was not significantly different over the range of neutron doses and amounted to 15.5 per cent of the weighted mean dose. The mean survival time over the thirty-day period of the decedents in each dosage group was increased by antibiotic therapy.

The beneficial effect of streptomycin is attributed to its action in preventing the occurrence of fatal bacterial infections. It is concluded that the generalized infections which follow neutron irradiation of mice are not merely a consequence of the moribund process but are a significant cause of death.

Three figures; 3 tables. AUTHOR'S ABSTRACT

Effect of X-Irradiation and Choline on the Reticulo-Endothelial System of the Rat. N. R. Di Luzio. Am. J. Physiol. **181**: 595–597, June 1955.

The blood clearance and organ distribution of colloidal radioactive gold were studied in normal, choline-treated, and whole-body x-irradiated anesthetized rats. The animals were studied at four, twenty-four, forty-eight, and seventy-two hours after administration of 1,040 r.

Treatment with choline for a period of three days resulted in an increased phagocytic velocity and a more efficient removal of the colloid. The tissue distribution of radiogold was unaltered. Whole-body irradiation immediately after the injection of colloidal radioactive gold produced a marked reduction in liver uptake of the isotope. At no time following irradiation was over-all phagocytic function, as indicated by the rate of removal of colloidal gold from the vascular system, impaired.

The distribution of radiogold in liver, lung, and spleen was altered in varying degrees and directions at various periods following total-body x-irradiation.

Two tables.

Histopathologic Changes in Irradiated Rats Protected by Parabiosis. Robert T. Binhammer, George Metz, Martin Schneider, and John C. Finerty, with the technical assistance of James K. Butler. Arch. Path. **59**: 594–606, May 1955.

Eighty female littermate rats, approximately forty days of age and weighing 120 ±5 gm., were placed in parabiosis within three hours after one partner had received a lethal dose of x-rays (700 r). The weight and microscopic structure of various organs were studied at two-day intervals during the period of parabiosis (twenty days). An immediate decrease in body weight and weight of hemopoietic and lymphopoietic organs occurred, with early onset of recovery at four days after exposure and parabiosis. Parabiotically protected rats showed rapid recovery of normal structure of these organs, although some regeneration was seen even in single, untreated irradiated animals before death. Adrenal weight increased in all experimental animals immediately after irradiation and/or pairing, with evidence of increased function. Irradiation caused destruction of follicles and ovarian interstitial tissue, and corpora lutea predominated in the exposed rats.

It is concluded that subsequent parabiosis protects lethally irradiated animals by maintaining them until regeneration of vital hemopoietic organs takes place and, in addition, may provide stimulation for more rapid regeneration *via* humoral factors.

[A paper covering a different phase of this study of the protective effect of parabiosis in irradiated rats appeared in Radiology (Schneider *et al.*: Protection of Irradiated Rats by Parabiosis with Adrenalectomized or Splenectomized Partners. Radiology **62**: 234, 1954).]

Fifteen photomicrographs; 4 graphs; 1 table.

After-Effects of X-Irradiation and Phenylhydrazine on the Hemoglobin, Serum Iron, and Reticulocytes of Rats. Alfred Chanutin and Elizabeth L. Word. Am. J. Physiol. **181**: 275–279, May 1955.

The present experiments were undertaken to determine the length of time that active substances, formed as a result of x-irradiation or phenylhydrazine injection, may be stored in the rat. Hemoglobin, serum iron, and reticulocyte measurements were made on (*a*) groups of irradiated animals subsequently injected at various time intervals with phenylhydrazine and (*b*) groups of phenylhydrazine-treated animals irradiated at varying periods after injection.

In both groups a marked anemia and hyperferremia were observed during the first five days subsequent to the final treatment. The results were regarded as compatible with the concept that substances formed by ionizing irradiation alone or by phenylhydrazine alone persist in the organism in a comparatively inactive form for an appreciable period.

Phenylhydrazine is capable of effectively stimulating bone marrow activity, as judged by blood reticulocyte counts, of animals previously exposed to total-body x-irradiation.

Seven charts.

The Effect of Thorium Dioxide (Thorotrast) on Metastases of the Walker Carcinoma 256 and the Relation of Tumor Size to Frequency of Metastases. Louis J. Bernard, Arthur M. Dutton, and Michael Radakovich. Cancer Res. **15**: 325–328, June 1955.

It has been suggested that the resistance of experimental animals to transplantable tumors and to the dissemination of metastases is dependent on the cells of the lymphoid-macrophage system. In the investigation described by the authors, reticuloendothelial system blockade was produced by Thorotrast in albino rats bearing Walker carcinoma 256 and the effect on incidence of tumor takes, tumor size at thirty days, and incidence and distribution of metastases was evaluated.

One hundred and four male Sprague-Dawley rats of the same age and weight were divided into two series of 64 and 40. Each series was subdivided by random selection into four equal groups. Two groups of each series were inoculated intradermally with an emulsion of Walker carcinoma 256, and the remaining two groups were given subcutaneous inoculations of the emulsion. All rats of a series received the same initial dose of inoculum. Forty-eight hours later Thorotrast was injected intravenously into one-half the animals. Decapitation was performed at thirty days and a careful search for metastases in the soft tissues was conducted. Findings were as follows:

1. Thorotrast had no effect on the incidence of tumor takes, on the final size attained by the tumors in thirty days, or on the incidence of metastases to the regional nodes, lungs, or other tissues.

2. Tumor implants of the same age and arising from the same dose of inoculum varied widely in final size. The incidence of regional and distant metastases correlated well with final tumor size at thirty days.

Three tables.

Serum Lipoproteins as an Indication of Survival Time in the X-Irradiated Rabbit. Thomas L. Hayes and John. E. Hewitt. Am. J. Physiol. **181**: 280–286, May 1955.

In rabbits given an LD 50 dose of x-irradiation, a strong relationship was found between increases in certain S_f classes of serum lipoproteins and time of death. S_f is the unit of flotation rate of the serum lipoproteins on ultracentrifugation according to a technic described by the authors. On this basis the "spectrum" of lipoproteins was divided into three ranges: S_f 5 to S_f 15, S_f 15 to S_f 30, and S_f 30 to S_f 400. The S_f 5 to 15 value represents, for example, the sum of concentrations of all serum lipoproteins that float on the ultracentrifuge with rates between S_f 5 and S_f 15 in a given solution density (1.063 gm./ml.)

Elevation of the S_f 30 to 400 class is correlated with death in from one to four days postirradiation. Elevation of the S_f 15 to 30 class is correlated with death in from five to thirty days postirradiation. Animals showing only minor changes in these lipoprotein classes survive beyond thirty days. The fact that an extremely large increase of serum lipoproteins apparently enhances survival may indicate a need for increased fat mobilization in the irradiated animal. The lipoprotein spectrum following irradiation can be used to distinguish at least two of the several types of injury sustained by the irradiated rabbit.

Eight graphs; 1 table.

Modification of the Radiation-Induced Increases in Phosphatase Activity of Hematopoietic Tissues by Chemical Agents. Donald F. Petersen and Kenneth P. Du Bois. Am. J. Physiol. **181**: 513–518, June 1955.

The authors have previously described a dose-dependent increase in the ability of the spleen and thymus gland of the rat and mouse to hydrolyze adenosine triphosphate and 5-adenylic acid after exposure to a sublethal dose of total-body roentgen irradiation (Am. J. Physiol. **176**: 282, 1954. Abst. in Radiology **63**: 917, 1954). It is now shown that certain agents affording protection against radiation injury—*p*-aminopropiophenone (PAPP), cysteine, and mercaptoethylamine—administered prior to irradiation cause reductions in the extent of this increase. Mortality studies demonstrated that the protective capacity of each compound coincided with its ability to diminish increased phosphatase activity, PAPP being the most effective of the agents tested. Greater improvement of survival and reduction in phosphatase activity was observed after the administration of a combination of PAPP and mercaptoethylamine than with either agent alone.

The results of the present study indicate the qualitative similarity of the three chemical agents in their ability to reduce radiation damage to the hematopoietic tissues and suggest common or closely related mechanisms of action. They indicate further the potential usefulness of adenosine triphosphatase and 5-nucleotidase assays for evaluating the efficacy of chemical agents in protecting hematopoietic tissues from radiation damage.

The Effectiveness of Colloidal Thorium Dioxide as an Internal Alpha Emitter: A Combined Morphologic and Radioautographic Study. Hermann J. Schaefer and Abner Golden. Yale J. Biol. & Med. **27:** 432–440, June 1955.

A series of rabbits was given various intravenous doses of Thorotrast and sacrificed after periods of twenty-four hours to nine months. Histologic sections and radioautographs were made of selected tissues.

All animals gained weight and appeared healthy during the experimental period, although most of them showed a distinct tendency toward macrocytic anemia. Histologic studies demonstrated a rapid uptake of Thorotrast by cells of the reticuloendothelial system. Accumulation of the thorium dioxide occurred progressively within these phagocytic cells of the liver, spleen, and bone marrow. Animals sacrificed at later dates all showed increasingly larger masses of the trapped metal in enlarged reticuloendothelial cells, sometimes in giant cells. Collection was least marked in the liver, next in the bone marrow, and greatest in the spleen, where tremendous conglomerate deposits were formed. Careful radioautography of selected sections showed the vast majority of alpha radiations to be trapped within the Thorotrast deposits themselves and indicated that little of the radiation escapes into the adjacent tissues. With very few exceptions, microscopic study of nearby cells showed no detectable evidence of radiation injury. In some of the animals sacrificed at later dates, there were limited numbers of degenerating cells in the areas adjacent to the radioactive deposits. In all instances, however, healing appeared to be progressing rapidly, without evidence of fibrosis or neoplasia.

Tables of calculated radiation doses from alpha-emitting thorium indicate a relatively high roentgen equivalent dose after a nine-month period, as in this study. However, the demonstrable effect of the radiation is not consistent, in that very few tissue changes were detected. The conclusion is that a great proportion of the radiant energy is "absorbed" within the deposit itself, so that the adjacent tissues receive only a relatively small dose. In the authors' opinion thorium deposits in the reticuloendothelial cells appear to be quite bland, at least during the time period of their survey.

Six charts; 16 photomicrographs.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Response of the Bat (Myotis lucifugus) to X-Irradiation. Douglas E. Smith, Donald R. Russ, and Eugenia M. Jackson. Radiation Res. **2:** 330–338, June 1955.

Survival, blood, and histologic studies were made in the bat (*Myotis lucifugus*) maintained in the laboratory at 23° C. and subjected to single, total-body x-irradiation (500 to 50,000 r). Non-irradiated starving bats survived much longer early (November) than later (February and March) in hibernation. In November experiments, dosages as low as 500 r significantly shortened the life span of the starving bats, but in February and March, exposures to 500 to 20,000 r were followed by survival times similar to those of simultaneously starved controls. Leukocytes were depressed by as little as 500 r, but the erythrocytes remained unchanged even after 20,000 r. Typical irradiation effects were found in bone marrow, spleen, lymph nodes, and duodenum after dosages as low as 500 r. These findings are compared with those in other irradiated mammals and frogs in an effort to establish the radiosensitivity of the bat.

Six graphs; 2 tables. AUTHORS' ABSTRACT

The Effect of X-Radiation on Enzyme Systems of Tetrahymena pyriformis. Jay S. Roth and Herbert J. Eichel. Biol. Bull. **108:** 308–317, June 1955.

Earlier studies by the authors (Biol. Bull. **104:** 351, 1953. Abst. in Radiology **62:** 639, 1954) showed that x-irradiation at a level of 300,000 or 500,000 r depressed the respiration of *Tetrahymena pyriformis W*, but did not appreciably affect the nuclease activity in homogenates prepared from irradiated whole cells. In irradiated homogenates, however, nuclease activity was reduced by approximately 50 per cent. The present paper gives some further observations on the effect of 300,000 to 600,000 r on respiration and several enzymes of *T. pyriformis S*. Both homogenates and whole cells were irradiated. At 600,000 r, respiration was significantly decreased; the activities of the succinic, glutamic, and malic dehydrogenase systems, catalase, and deoxyribonuclease (DNase) were depressed in homogenates irradiated at this level. Within a short time after irradiation, catalase activity was completely recovered in homogenates allowed to stand at 0°. Irradiated cells revealed only minor changes in succinic dehydrogenase activity.

Whole cells irradiated with 600,000 r in the presence of 2,6-diaminopurine were considerably protected from the effects of radiation on respiration for a short time after exposure. Cells of the W strain, irradiated with 300,000 r and then placed in the presence of *L*-phenylalanine, showed a loss of ability to oxidize this compound compared to controls. Under the same conditions, acetate stimulated the oxygen consumption of x-irradiated cells to a much greater degree than that of control cells when measured thirty minutes after irradiation. Some effects of sulfhydryl reactants on succinic dehydrogenase and deoxyribonuclease activities of homogenates were studied, and the general implications of the results are discussed.

Seven tables.

X-Ray Effects on Adult Artemia. Daniel S. Grosch and Howard E. Erdman. Biol. Bull. **108:** 277–282, June 1955.

Information available on the lethal dosage of ionizing radiations in animals is limited to a certain few microorganisms, selected insects, and laboratory types of vertebrates. Even more limited has been research on radiation-induced sterility in females. Because there are extreme differences between results with vertebrates and those with holometabolous insects, it is of interest to fill in the gaps by extending research to a wide variety of representative animals. The authors report an investigation of a primitive order of crustacea, *Artemia salina* (a brine shrimp).

As adults, *Artemia* males were found to be killed by 200,000 r of x-radiation; females by 150,000 r. This approaches the dose required to kill adult holometabolous insects. Neither insects nor the brine shrimp depend upon mitotic tissues in adulthood. A dose of 2,000–3,000 r sterilized *Artemia* females; this is lower than the dose required in insects with polytrophic ovarioles and higher than in grasshoppers with simpler panoistic ovarioles.

One figure; 1 table.

Effects of Various Levels of X-Irradiation on the Gametes and Early Embryos of Fundulus heteroclitus. Roberts Rugh and Helen Clugston. Biol. Bull. **108:** 318–325, June 1955.

The authors describe an investigation made to determine (1) the levels of radiation sensitivity of the egg, sperm, and early cleavage stages and (2) the effect of irradiation upon early development of the embryo of the fish, *Fundulus heteroclitus*.

X-irradiated eggs, whether exposed to 1,000 r or to 200,000 r, showed separation of membranes to form a perivitelline space, generally considered as one of the criteria of successful fertilization. None of these eggs, however, proceeded to cleave.

Eggs exposed to 100,000 r within the body of the female were sometimes fertilizable with normal sperm, and many developed as far as Stage 17 (Oppenheimer, J. M.: The Normal Stages of *Fundulus heteroclitus*. Anat. Rec. **68:** 1, 1937) without gross teratologies. While lordosis was frequent, due to imperfect development of the central nervous system, the pulsating heart was generally found functioning without benefit of corpuscles.

Sperm irradiated to 200,000 r and used to fertilize normal eggs could often produce quite normal development to twelve days, when the embryos were comparable to the controls at eleven days. These may have been haploids, due to a genetically non-functional nucleus.

An exposure of the spermatozoa to 100,000 r frequently resulted in quite normal embryos that were able to hatch.

The first (or earliest) cleavage is the most vulnerable to irradiation insult, such embryos tolerating a maximum of 300 r without gross abnormalities. Following 1,000 r the embryos were unable to achieve any neural differentiation.

A dose of 1,000 r to the expanding blastula (Oppenheimer Stage 11) was qualitatively comparable to a dose of about 500 r to the first cleavage stage.

The anterior neural structures appear to suffer most following x-irradiation of any embryonic stage from the first cleavage through the expanding blastula. Pulsating hearts without corpuscles were often found.

Point x-irradiation of a single cell of the two-cell stage with polonium (20,000 rep) appears to damage the cell to such an extent that regulation and successful gastrulation cannot be achieved, except in rare instances. This may be due to mechanical factors or to a quantitative alteration of the blastoderm-yolk relations.

Seventeen figures.

Effects of Ionizing Radiations on Seeds of Barley. Richard S. Caldecott. Radiation Res. **2:** 339–350, June 1955.

Barley seeds soaked for more than three hours at 3° C. are more sensitive to x-rays and fast neutrons than unsoaked seeds. They are less sensitive, however, to thermal neutrons. The results with fast neutrons may be explained by the fact that most of the ionization results from hydrogen nuclei being set in motion by collision and the hydrogen available is augmented by hydration. The thermal neutron data appear to be best explained by the fact that in the unsoaked seed over 90 per cent of the ionization results from protons and alpha particles from capture of thermal neutrons by nitrogen and boron, respectively. Thus, when the water content is increased, the ratio of nitrogen and boron to the total elemental constituents of the seeds is decreased. From this it follows that the biological efficiency of the thermal neutron decreases with hydration.

The sensitivity of seeds to x-rays is increased when they are stored at low relative humidities in contrast with high relative humidities. Thus, there is an inverse relationship between water content and x-ray sensitivity. The same situation may pertain for thermal and fast neutrons, but the differences are of a lower order of magnitude.

Soaking seeds for periods up to twenty-four hours and then dehydrating them augments their sensitivity to x-rays. It appears to have little or no influence, however, on their sensitivity to thermal and fast neutrons.

Nine figures; 1 table. AUTHOR'S ABSTRACT

Evidence for Two Types of X-Ray-Induced Lethal Damage in Saccharomyces cerevisiae. Robert K. Mortimer. Radiation Res. **2:** 361–368, June 1955.

X-ray survival curves for haploid yeast cells are generally exponential, while those of diploid cells are sigmoid. This has suggested the involvement of recessive lethals in cellular inactivation; one such mutation would be lethal to the haploid cells but at least one allelic pair of such mutations would be necessary to kill the diploid cells. Results obtained with triploid and tetraploid yeast cells indicated that dominant lethal damage may also be involved.

In order to test this assumption, a micro-mating experiment was devised and undertaken. Haploid cells of one mating type were irradiated and paired individually with unirradiated haploid cells of the opposite mating type. The diploid zygotes formed showed evidences of radiation damage, including swelling, division delay and death. With doses which were lethal to nearly all the haploid cells, a relatively large percentage of zygotes were still able to survive, indicating that the haploid cells were mostly being inactivated by damage operationally similar to recessive lethal damage. The zygotes which were inactivated were considered to have suffered a dominant lethal form of damage, since only one of the parental cells had been irradiated. The relative sensitivities to recessive and dominant lethal damage in the haploid cells was in the ratio of 15:1. This ratio would be expected to decrease sharply with increasing ploidy and this can account for the greater sensitivity of tetraploid compared to diploid yeast cells.

One graph; 1 table. AUTHOR'S ABSTRACT

Effect of Body Backscatter in Gamma-Ray Personnel Dosimetry. Leonard R. Solon and Hanson Blatz. Nucleonics **13:** 62–64, April 1955.

Measurements are described to evaluate the effect of the back-scatter from the human body on a film badge or pocket dosimeter when the wearer is exposed to gamma rays from either cobalt-60 or radium. Ordinarily, dosimeters are calibrated in free air. To simulate back-scatter from the body, a phantom consisting of polished rice and sodium bicarbonate was used which had a slightly higher specific gravity and electron density than water. The experimental arrangement of both pocket dosimeters and film badge holders is described, together with the arrangement of the radiation source and of the phantom material. A description is also given of the HASL (Health and Safety Laboratory)

film badge, together with the densitometry procedure, which involved measurements of the shielded portion of the film, but not of the open-window area. The conclusion is that for gamma rays of the energies investigated no back-scatter correction is necessary for the HASL film badge or for pocket dosimeters.

Two tables. JOHN S. LAUGHLIN, Ph.D.
Memorial Center, N. Y.

Radiation Protection Measurements in Relation to the Additional Dose Caused by Neutrons During the Operation of a 15 Mev Betatron. D. Hofmann. Strahlentherapie **97**: 239–245, June 1955. (In German)

While the peak energy of the first betatron marketed by Siemens-Reiniger Werke (Germany)—6 Mev—was below the level required for the appearance of a significant amount of incidental nuclear reactions, the recently introduced 15-Mev model reaches well into the range where the additional dose of ionizing particles could conceivably be of more than theoretical importance. Other authors have proved that the artificial radioactivity produced in the tissues by the betatron beam can be disregarded for practical purposes. This paper presents qualitative and quantitative measurements of the neutron flux in a 15-Mev betatron beam, considering that the total dose might be increased by the recoil protons resulting from the collision of neutrons with hydrogen nuclei.

The experimental procedure, which is fully described, involved the use of special ("nuclear") photographic plates having an emulsion of 100 microns thickness. Doses were determined with a thimble chamber, embedded in a paraffin cylinder, having a 3-cm. wall thickness to insure the equilibrium of secondary electrons.

The spectrum of the recoil protons ranged from 0.25 to 4.0 Mev, with a maximum between 1.25 and 1.5 Mev. As expected, the compensation filter and the collimating system, both made of lead, give off relatively large numbers of neutrons. In the central beam their direction is more or less axial, but in the collimator scattering prevails. The unfiltered and non-collimated gamma beam contains few neutrons. Incidentally, a plate exposed to 1 r of electron beam, behind an 8-mm. lead filter, revealed the fairly high concentration of 68 proton tracings per 10 mm.^{3} of emulsion volume.

Considering the average proton energy of 1.33 Mev and its average ionization energy in tissue of 32 ev, in the central beam, at 50 cm. from the target, the dose caused by neutrons will represent 9.5×10^{-3} r per 100 r of the gamma dose. Computed for a 20 r/minute betatron beam and eight hours, the neutron dose (9.1×10^{-1}) is about ten times higher than the accepted tolerance margin of 0.1 r; even on the outside of the collimator, the neutron dose (1.6×10^{-1}) is still slightly above tolerance. In the central beam, the calculated neutron flux is 3.8×10^5 neutrons per cm.^{2}/second, while adjacent to the collimator it would be 7.4×10^4 neutrons per cm.^{2}/second. As far as therapeutic applications are concerned, the additional dose produced in the tissues by these neutrons (actually by recoil protons) is insignificant if compared with the ionization given by the betatron beam.

One photomicrograph; 1 graph; 2 schematic drawings. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

X-Ray Critical Absorption and Emission Energies in kev. S. Fine and C. F. Hendee. Nucleonics **13**: 36–37, March 1955.

A useful and comprehensive table of critical absorption and emission energies for all of the elements up to element 98 is presented. Values are given in kilo electron volts to the third place following the decimal, for components of both the K series and L series. The sources of the data and methods of energy conversion interpolation are briefly described.

One table. JOHN S. LAUGHLIN, Ph.D.
Memorial Center, N. Y.

April 1956

collimator
-collimated
dentally, a
d an 8-mm.
ation of 68
ume.
f 1.33 Mev
of 32 ev, in
et, the dose
$^{-3}$ r per 100
inute beta-
ose ($9.1 \times$
epted toler-
of the col-
still slightly
e calculated
m.^{2}/second,
e 7.4×10^4
eutic appli-
produced in
recoil pro-
e ionization

matic draw-
GG, M.D.
, Chicago

Energies in
es **13**: 36–37,

tical absorp-
ments up to
in kilo elec-
decimal, for
series. The
y conversion

LIN, Ph.D.
ter, N. Y.

MA